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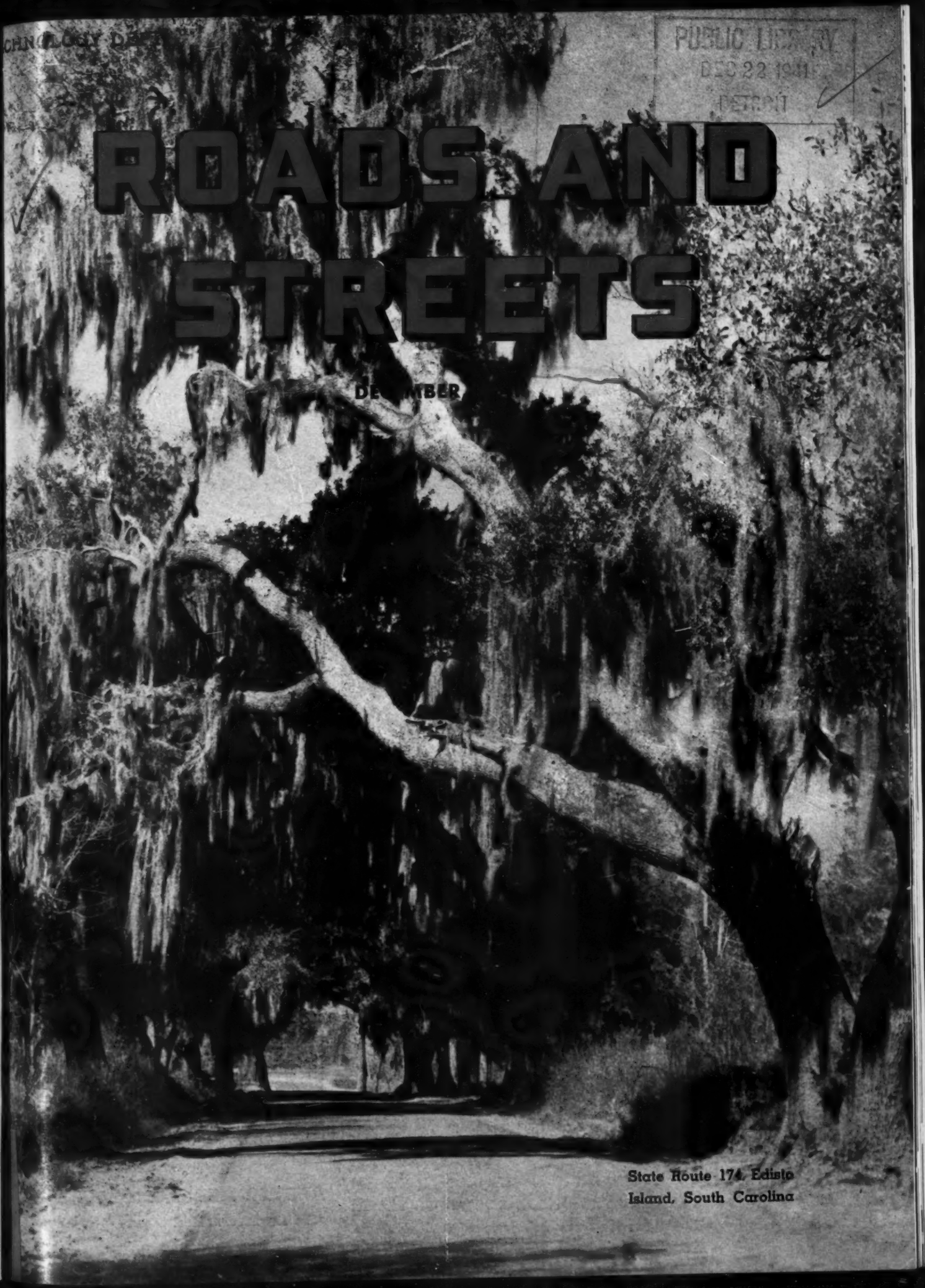

State Route 174, Edisto Island, South Carolina

GEMMER

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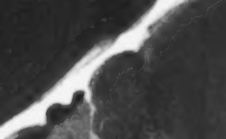

AS THE GIANT peaks tower above the surface of the earth, so Gemmer Triple Roller Tooth Steering Gears tower above other devices in all of the essential factors for desirable steering control; indisputably the pinnacle in steering.

"Passenger car ease"—maximum safety in steering—are provided for commercial vehicles of all kinds—including road machinery, trucks, tractors and buses.

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The Symbol of Steering Excellence

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MORE LIGHT FOR NIGHT DRIVING

from New Reflecting Safety Curb

These pictures of New York State Highway tell story of greater visibility and traffic safety assured by White Concrete Reflecting Curb

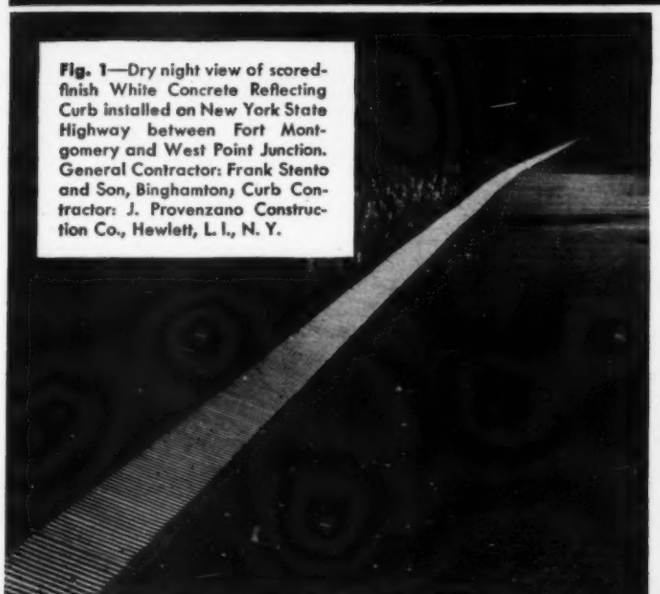

Fig. 1—Dry night view of scored-finish White Concrete Reflecting Curb installed on New York State Highway between Fort Montgomery and West Point Junction. General Contractor: Frank Stento and Son, Binghamton; Curb Contractor: J. Provenzano Construction Co., Hewlett, L. I., N. Y.

WHY White Concrete Reflecting Curb is an important contribution to safety on roads and streets is clearly shown in these two photographs.

On a dry night, under car headlights only—no other illumination—White Concrete Reflecting Curb defines the road far ahead of the car. Why? Because the white concrete is a good reflector, and because the saw-tooth faces of *reflecting* curb (as explained in Figs. 3 and 4) make the curb highly visible by reflecting the headlight rays back to—not away from—the driver.

On a rainy night, when the pavement is almost completely blacked out, *reflecting* curb provides a brighter guide to safety than on a dry night. Why? Water on the reflecting faces fills in the minor depressions in the white concrete, creating a smoother, more mirror-like surface which reflects even more light back to the driver and thus makes the curb even more highly visible.

White Concrete Reflecting Curb made with Atlas White cement has proved its efficiency and economy in many installations. Although relatively new, it has been installed or specified in 16 states.

WHY REFLECTING CURB IS HIGHLY VISIBLE

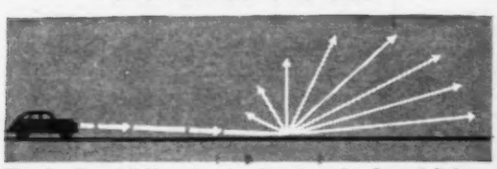

Fig. 3—For visibility of curb, *direction* of reflected light is as important as the *amount* of light. Car headlights strike *smooth* curb or pavement at a flat angle, and thus nearly all the light is wasted—it is reflected forward, in the *wrong* direction, *away* from driver. Visibility is poor, and on rainy nights is almost nil.

Fig. 4—When car headlights strike the saw-tooth faces of reflecting curb, the light is conserved—it is reflected in the *right* direction, *back* to the driver, forming a bright guide to safety. Visibility is high on dry nights and higher still on rainy nights (explained above, right).

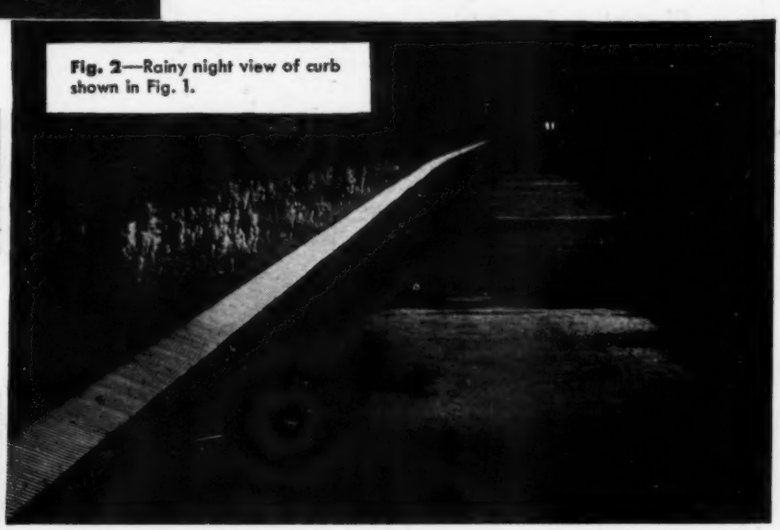

Fig. 2—Rainy night view of curb shown in Fig. 1.

Use the coupon to ask for your copy of the first complete and authentic publication on White Concrete Reflecting Curb. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Bldg., New York City.

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ROADS AND STREETS

Vol. 84, No. 12 • December, 1941

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Copyright 1941, by Gillette Publishing Company. Acceptance under the Act of June 5, 1934, authorized January 25, 1938, at Chicago, Illinois. Subscription price $3.00 per year in the United States, $3.60 per year in Canada, $4.00 per year for foreign mailing.

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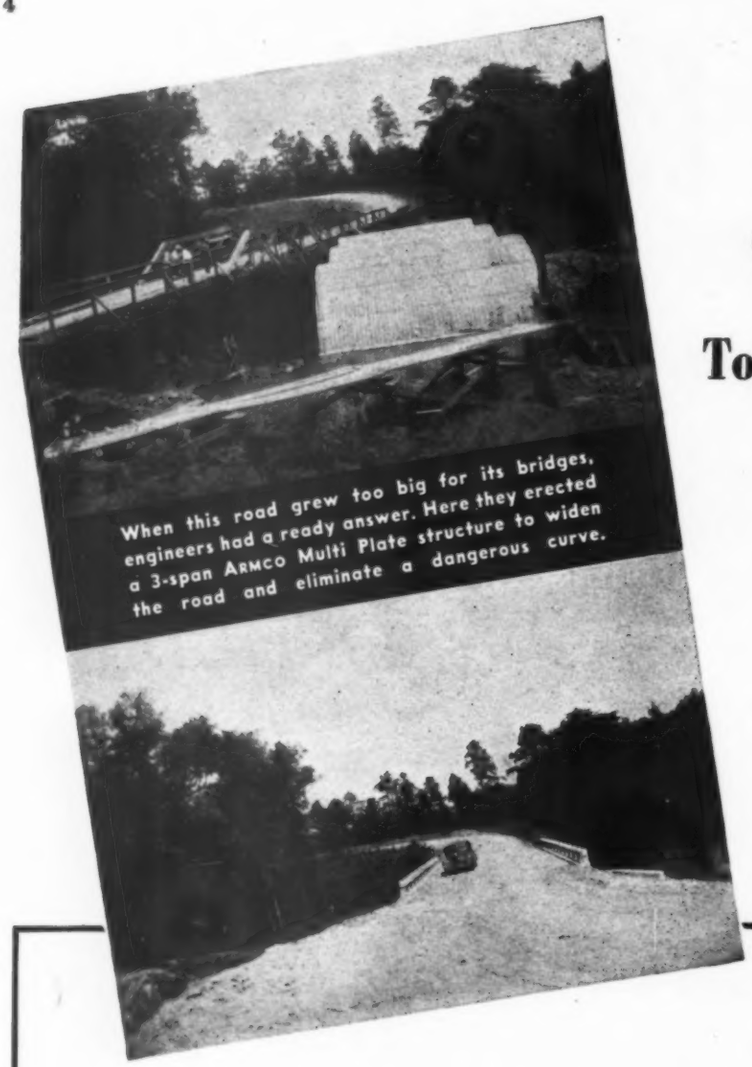
When this road grew too big for its bridges, engineers had a ready answer. Here they erected a 3-span ARMCO Multi Plate structure to widen the road and eliminate a dangerous curve.

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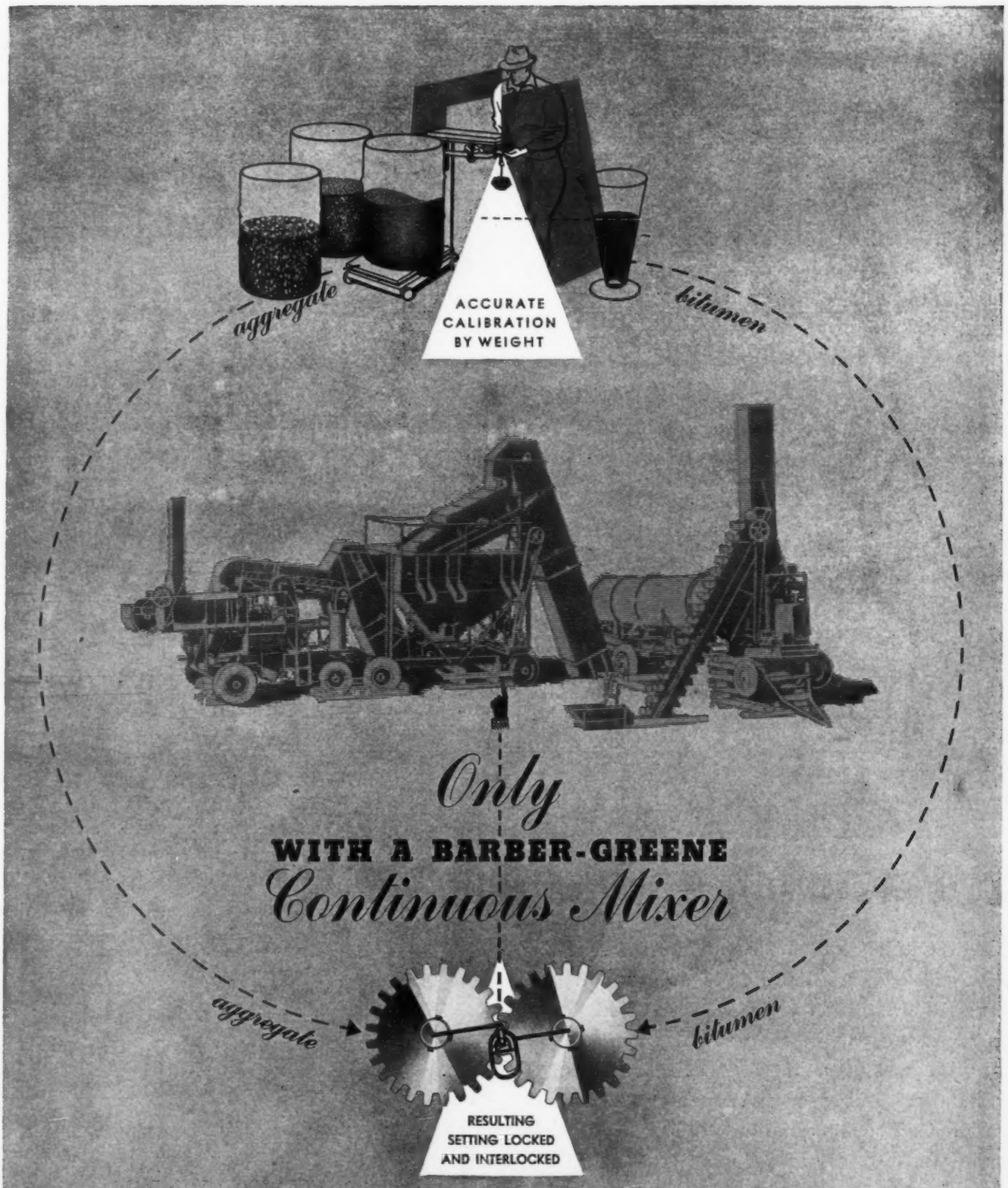

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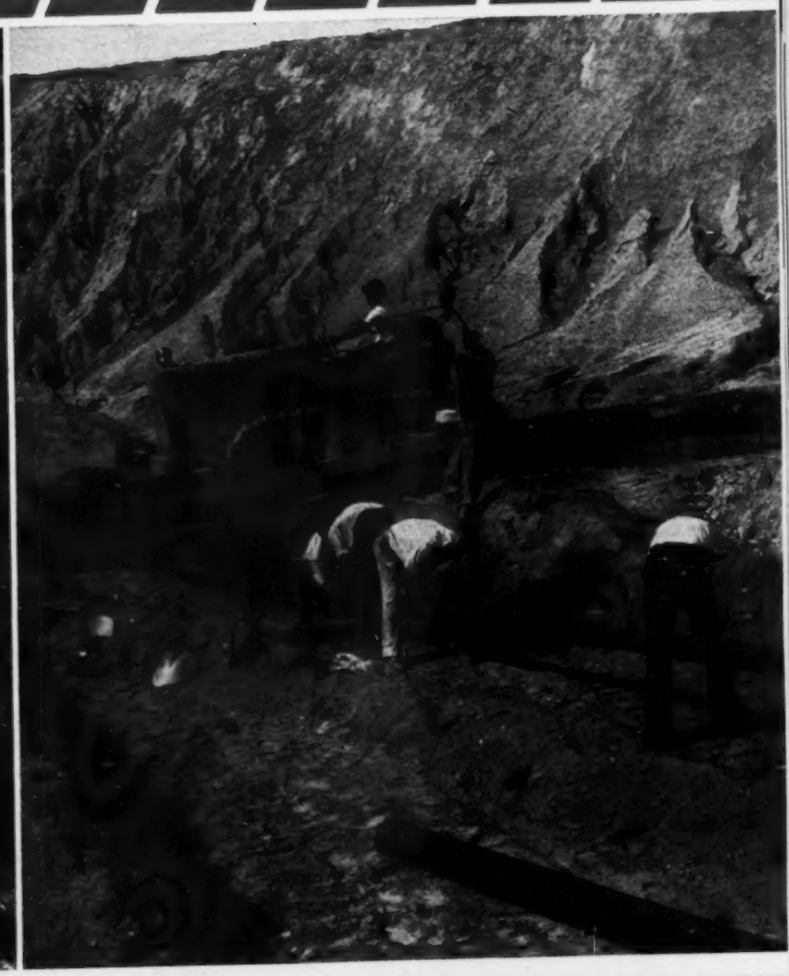

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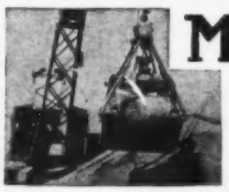

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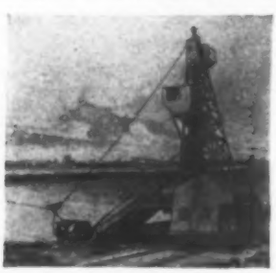

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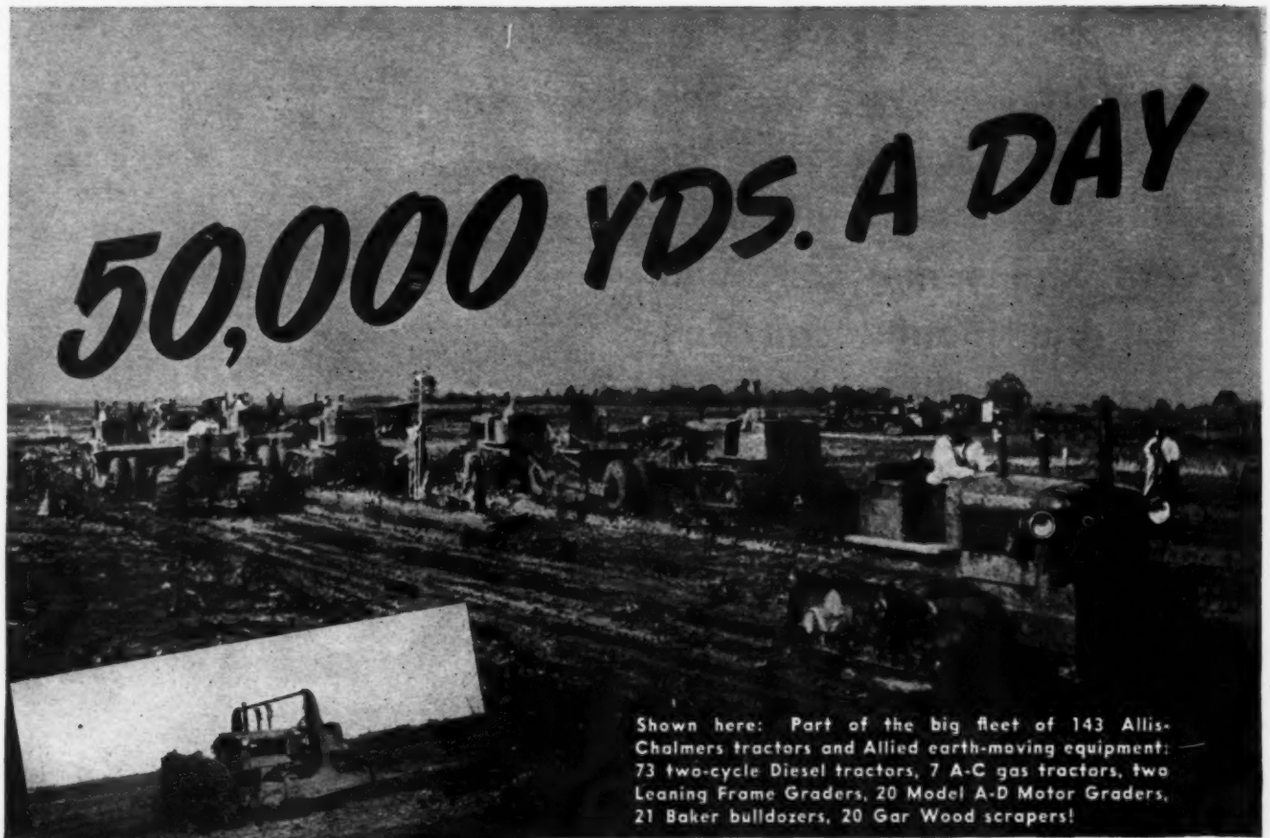

Shown here: Part of the big fleet of 143 Allis-Chalmers tractors and Allied earth-moving equipment: 73 two-cycle Diesel tractors, 7 A-C gas tractors, two Leaning Frame Graders, 20 Model A-D Motor Graders, 21 Baker bulldozers, 20 Gar Wood scrapers!

21 of these 2-cycle Diesels are equipped with Baker bulldozers. Operators throttle through bulldozing, smoothly, quickly. Hanging-on ability of 2-cycle engine means less gear-shifting . . . more work done.

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BIG is a one-word description of what's taking place on the Southwestern Proving Ground, ordnance project, Hope, Arkansas. BIG the way Uncle Sam does it . . . and BIG the way W. E. Callahan Construction Company is doing it. Over 4,000,000 cubic yards are being moved . . . at the astounding daily average of 50,000 yards. 70,000 yards scored one day! The huge undertaking is being rushed through by "an array of equipment that rivals the claims of some highly touted mechanized armies".* A major part of the big mechanized force are Allis-Chalmers and Allied manufacturers' equipment. 143 UNITS! 73 TWO-CYCLE DIESEL TRACTORS, 7 A-C GAS TRACTORS, TWO LEANING FRAME GRADERS, 20 MODEL A-D MOTOR GRADERS, 21 BAKER BULLDOZERS, 20 GAR WOOD SCRAPERS! On 24-hour duty . . . hitting a fast, steady pace . . . they're out for a record in time and cost . . . and are setting it!

*** According to the Public Relations Director of the Hope Project.**

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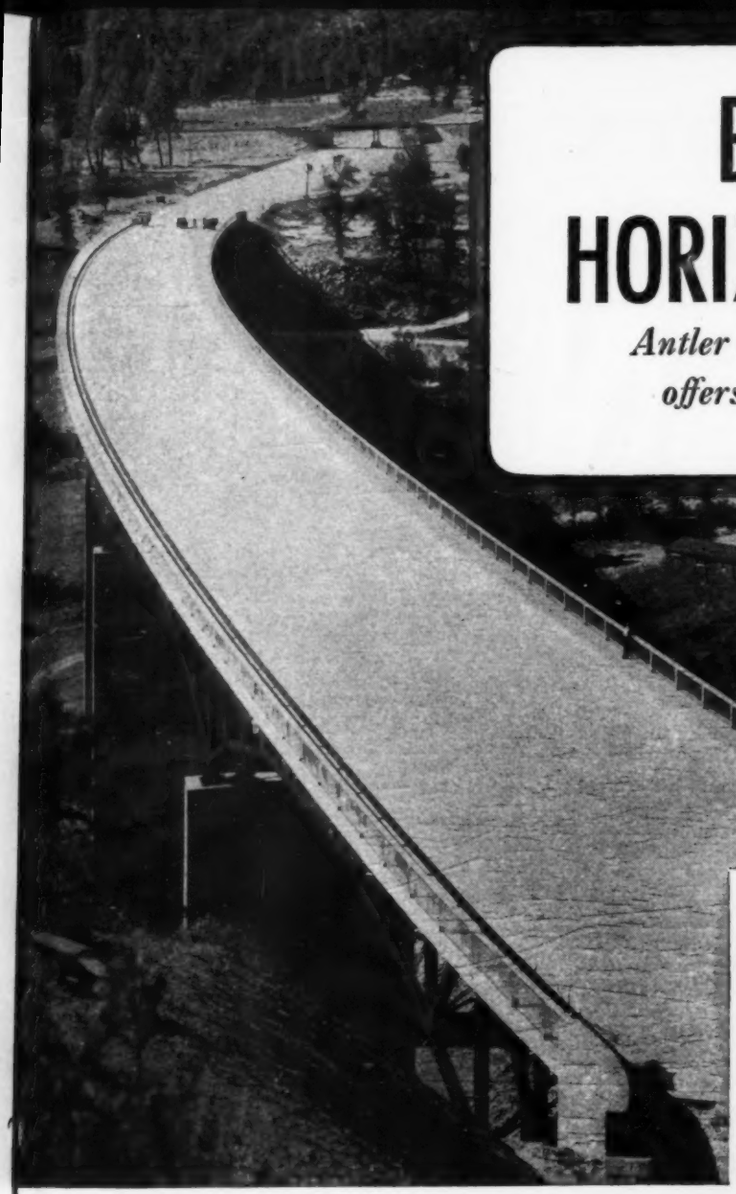
Antler Bridge over Sacramento Canyon offers interesting features of design.



The Antler Bridge, built jointly by the U. S. Bureau of Reclamation and the State of California, was designed and constructed under the direction of the State Highway Engineers. The United Concrete Pipe Corporation was the General Contractor.

PERHAPS the major project in the relocation of approximately 16 miles of state highway, made necessary by the construction of Shasta Dam, is the Antler Bridge.

It spans the Sacramento River Canyon, at Antler, California, some 18 miles above the site of Shasta Dam.

This is an impressive 1330-foot deck structure carrying a 50-foot, 4-lane concrete roadway flanked by 2½-foot sidewalks. The roadway is built on a vertical grade descending northwardly. It sweeps across the canyon on a horizontal curve of 850-foot radius. Its lines are pleasingly symmetrical.

Of the six supporting concrete piers, the tallest rises 172 feet above its footing. The highest point of the roadway deck is some 210 feet above the low water of the Sacramento. However, upon the completion of Shasta Dam, the backed-up waters will come to within 80 feet of the highest point—practically leveling-off with the tops of the piers at the low end of the structure.

ROADWAY VIEW AND ELEVATION OF THE ANTLER BRIDGE. The impounded waters of Shasta Dam eventually will rise to the approximate level of the concrete pier-tops, inundating the Sacramento river valley.

The steel superstructure, excepting for short beam approach spans at either end, is a symmetrical arrangement of 5 truss spans: two of 189 ft., two of 252 ft., and a central span of 273 ft. The 189-ft. and 252-ft. spans are grouped into two continuous units. Each unit cantilevers 63 feet beyond the central piers to support the 147-ft. suspended truss of the 273-ft. central span; also cantilevers 42 feet beyond the end piers to carry the beam span approaches. Of unusual interest is the truss design which utilized throughout CB Sections for component members—replacing the conventional laced and plated assemblies.

American Bridge Company, as sub-contractor to Columbia Steel Company, fabricated and erected the approximately 1700 tons of steel which entered into this construction.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit
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Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

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DEFENSE

won't wait for weather!

IN THE first nine months of 1941 the men and machines of America's earth-moving industry have dug, scraped, hauled and bulldozed more than 800,000,000 cubic yards of dirt and rock — all on defense work!

The fact that much of this immense yardage has been handled under the toughest kind of conditions is a tribute to the rugged power, traction and stamina of "Caterpillar" Diesel Tractors and Motor Graders. These sturdy machines ask no favors of terrain or weather. In deep, soft mud, on sun-baked clay or frozen ground, they come out slugging, right from the bell.

The broad steel tracks of a "Caterpillar" Diesel Tractor furnish solid footing for its tremendous engine power, and the final drive is protected from mud, water and grit by copper bellows-seals. Balancing engine weight over the drive wheels gives a "Caterpillar" Diesel Motor Grader its unbeatable tractive power. Both machines start fast and run smoothly whether the temperature is zero or 100. And both operate with better-than-average Diesel economy because they use the cheaper grades of fuel.

Most important of all, *they're built to stand up under punishment* — to work day and night, month after month, with a minimum of lost time.

Every minute counts in the present emergency, and "Caterpillar" dependability has a vital part in licking America's biggest job.

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DIESEL

ENGINES AND ELECTRIC SETS

TRACK-TYPE TRACTORS • ROAD MACHINERY

Under a scorching sub-tropic sun this "Caterpillar" Diesel No. 12 Motor Grader windrows dirt for airport construction at Felton Field, Pensacola, Florida. Dual engine cooling keeps both water and oil at the proper temperature.

A "Caterpillar" Diesel No. 12 Motor Grader building road through a swampy area at the Aberdeen Proving Grounds.

At the U. S. Army Proving Grounds, Aberdeen, Maryland, a "Caterpillar" Diesel D7 Tractor with LaPlant-Choate bulldozer works in heavy March mud.

STRONG AS A GRIZZLY...

handles like a kitten

Bethlehem Purple Strand Form-set Wire Rope combines two of the most important qualities a wire rope can have: strength and easy handling.

Bethlehem Purple Strand is made of 100 per cent Improved Plow Steel, the strongest, toughest steel used in wire rope.

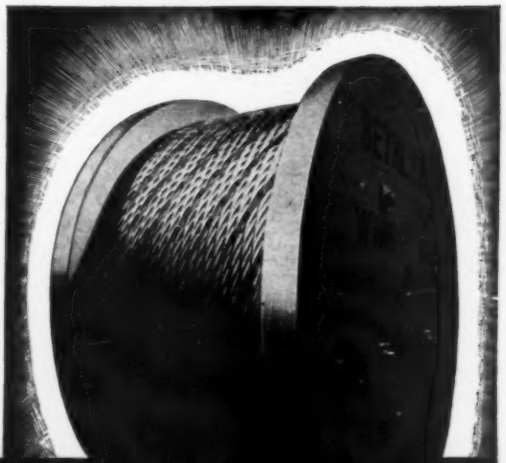
Preforming of this husky high-strength steel produces a rope that is easy to handle as well as rugged. Form-set, Bethlehem's preformed rope, is relaxed, less apt to kink or loop. Cut ends need not be seized. Broken wires won't bristle out of place. And finally, because the rope is preformed, it is better able to stand bending fatigue, thus materially increasing service.

Next time you buy wire rope for a job that requires both strength and ease of handling, get Purple Strand Form-set. It has the stamina for long service, plus the workability that speeds up operations.

PURPLE STRAND

FORM-SET

WIRE ROPE

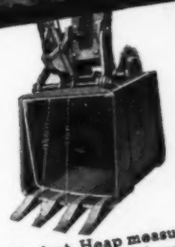


BETHLEHEM STEEL

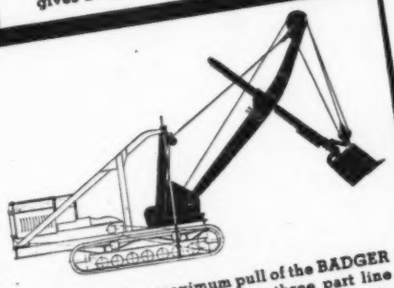
BETHLEHEM STEEL COMPANY

THERE'S NO FOOLIN' AROUND

WITH A 3/4 SWING BADGER ON THE JOB



The BADGER'S level full measure is exactly 12 cubic feet. From top of teeth to back of dipper it measures 13-1/2 cubic feet. Heap measure gives a capacity in excess of a full half yard.



The single line maximum pull of the BADGER is 10,000 pounds. Thus the three part line used results in a 30,000 pound pull . . . tremendous digging power.

Diagrams above show greater period of FULL SPEED provided by the BADGER'S faster start and stop. This extra period of *full speed* is possible because the BADGER has no excess load to be brought to full speed, stopped and reversed within the limits of a short swing.

● Every feature of conventional shovel design that is an obstacle to speed and output has been eliminated in building the A-W BADGER.

Size of dipper . . . digging speed . . . speed in swinging . . . low center of gravity that makes it possible to use 15 tons of upward pull for ripping through any material . . . ALL contribute to the BADGER'S amazing output.

An investigation will demonstrate conclusively that no full-swing shovel can approach the BADGER on these output-increasing points. Yet the BADGER 1/2-yard Shovel is priced lower than many 3/8-yard shovels. See it perform as a shovel, dragline, trench hoe, pile driver or skimmer before you buy. THE AUSTIN-WESTERN ROAD MACHINERY CO., Aurora, Illinois.

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MOTOR GRADERS	HYDRAULIC SCRAPERS	ROLL-A-PLANES
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The whole family will appreciate the extra comfort, convenience and security you get at **AHA** hotels. Get a real night's rest in the safety of a modern fireproof building and enjoy all the conveniences and delights of civilized living at its best. In the morning enjoy an invigorating bath and a delicous breakfast...there's your fresh start. Experienced travelers know and watch for the **AHA** emblem...the extra rest gives added zest for the journey ahead.

step up (NOT DOWN) **when you travel**

AMERICAN HOTEL ASSOCIATION
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ROCK is no TOUGHER today than in 1895

• You can't do the same thing for 46 years and not learn a lot about it—and Thew started to learn about rock shovels in 1895, when the first Thew was produced.

Though rock is no tougher today than in 1895, Thew-Lorain rock shovels are! The new, modern 2-yd. Lorain-82 pictured below typifies the latest in Thew's long line of rock shovels. It's a vast improvement over the "old timers," shown above, in power, strength, speed and output. It's but one of the many current Lorains that reflect the value of this 46 years' experience . . . a value which they demonstrate in today's terms by digging more rock, faster, at lower cost.

THE THEW SHOVEL COMPANY, LORAIN, OHIO

LORAIN Rock Shovels 1895-1941

THEW CENTER DRIVE

WHO SAYS— There ain't no such animal?

HERE IT IS! Here's the biggest thing in 'dozer history —the Buckeye UNITILT design that brings you a combination of advantages never before built into any one unit!

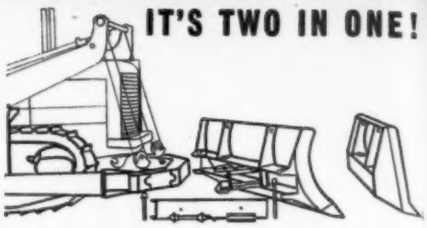
Interchangeable blades that mount on the same frame . . . a blade curvature that digs its own way in and rolls the dirt ahead—no mechanical down pressure needed . . . close-coupled construction with a Trailbuilder blade that's *closer to the radiator than any other trail blade built*—no heavy front end load—perfect balance all the time . . . Buckeye's patented tilting device to raise or lower the blade with a twist of the wrist . . . high lift, unlimited digging depth . . . cable control at its best with fast, powerful, smooth-acting Buckeye Power Control Units!

When you put Buckeye Blades and Buckeye Hoists on your tractors, you'll smash your way through the toughest going before you know you're in it!

Write for specifications and literature today.

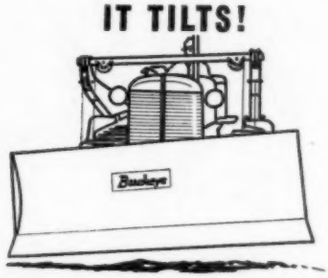
BUCKEYE TRACTION DITCHER CO.
Findlay, Ohio

IT'S TWO IN ONE!



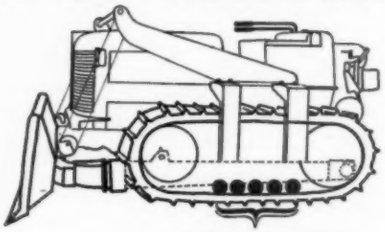
Bulldozer or Trailbuilder on a universal frame! Just change the blades—a quick, easy job accomplished by pulling two kingpins.

IT TILTS!



Bulldozer as well as Trailbuilder tilts! You can use the Bulldozer moldboard for many types of trailbuilder work! Tilting device is adjusted by one nut!

IT "HUGS" THE RADIATOR!



THE WEIGHT IS HERE!

Buckeye blades hang *close* in to the tractor reducing heavy overhanging load and keeping the tractor in *balance!* The weight is distributed where it belongs—on *all* the track rollers! This saves wear and tear on front idlers and front track rollers!

IT'S FINGERTIP CONTROLLED!

Buckeye Cable Control units give lightning-fast action, powerful lift with no jerk on the line! Smooth, easy, finger-tip control for bigger yardage per day!

Built by Buckeye

Convertible Shovels

Trenchers

Tractor Equipment

R-B Finegraders

Road Wideners

Spreaders

ROADS AND STREETS

December, 1941, Vol. 84, No. 12

General Observations on Concrete Scaling

Organic Admixtures Showed Satisfactory Resistance

By **J. W. KUSHING**
Research Engineer, Michigan State Highway Department

A PRELIMINARY survey of all concrete pavements in Michigan shows that approximately 10 percent of the surface is scaled in varying degrees. Other states in corresponding climatic zones have experienced similar scaling conditions. This condition has become more apparent as the use of chemical salts has increased for the removal of ice from pavements. The use of concrete for pavements during the last 30 years has demonstrated its many desirable properties as a paving material. Scaling of concrete pavements in Michigan has not indicated that any of the properties have been seriously impaired by its action or that the use of chemical salts and resultant scaling have lead to any definite failure. Scaling has been common in most parts of the state, but on a whole the concrete is predominantly good. But even so, the unsightliness of scaled areas, the necessary subsequent maintenance and the added possibility of further deterioration is of immediate concern to the highway engineer.

This concern leads the engineer to the consideration as to "what to do" about the problem. Logically in order to attack such a problem some information of a fundamental nature must be obtained as regards the cause of the scaling. Then on the basis of the information formulate corrective measures. The study of scaling and the use of preventative measures has not altogether followed this plan. Quite by accident certain admixtures when used in concrete have been found to arrest scaling for a period of time, the length of which must be determined by further research. These admixtures have been used on a trial experimental basis with a certain amount of success, but all of the causes of scaling or any positive reason why these admixtures work has not as yet been definitely determined.

In studying the problem of scaling a definite philosophy should be adopted, as to whether, ice control and methods now used should direct the basis of the investigation or whether new methods of ice control should be developed. It would appear that the most logical attitude to take is that the use of "salts" for ice removal is the cheapest and most efficient method we know and that the problem should be one concerned with what to do about the concrete to prevent scaling.

The Michigan State Highway Department was one of the pioneers in the development of ice removal methods, perhaps due to the geographical location of the state and the resultant ice formations on pavements. Abrasives, chloride salts, serrated blades and other methods have been used to control slippery conditions of pavements with satisfactory results. As an effect of the use of a considerable amount of salts in the control program an increased amount of scaling was noticed on the concrete slabs.

Consequently, in 1939, a study of scaling, its causes and methods for prevention was incorporated into the plans of the Research Division of the Michigan State Highway Department as a definite project under the title "Durability of Concrete."

This investigation has been di-

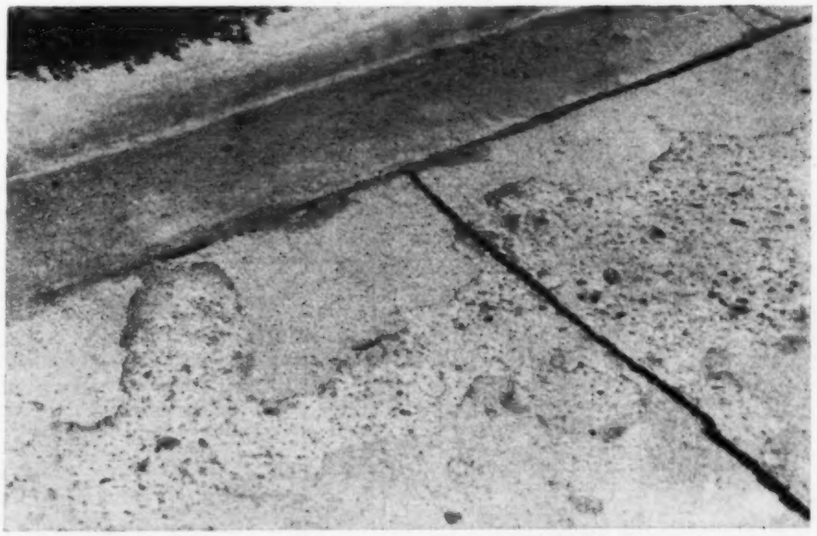


Fig. 1.—Typical Scaling of Concrete Pavement

CODING SHEET — CONCRETE PAVEMENT SCALING STUDY.

LINE NUMBER	CONTROL	COUNTY	PROJECT	CONTRACT	YEAR BUILT	AGE	DISTRICT	LOCATION	AVERAGE DAILY TRAFFIC 1938	CURING	FINISHING	CONTRACTOR	LENGTH Miles	THICKNESS EDGE Inches	THICKNESS CENTER Inches	WIDTH Feet	CEMENT	FINE AGGREGATE	COARSE AGGREGATE	SURFACE AREA SQUARE YARDS	LIGHT SCALE SQ. YDS.	LIGHT SCALE %	MEDIUM SCALE SQ. YDS.	MEDIUM SCALE %	HEAVY SCALE SQ. YDS.	HEAVY SCALE %	TRANSV. CRACK SPACING Feet	EXP'N JOINT SPACING Ft. In.	CONTRN JT. SPAC. Ft.	DOWEL JT. SPAC. Ft.
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Fig. 2.—Coding Sheet for Pavement Survey Study

vided into two separate studies; first, a field study including a survey of existent concrete pavements and a special study of a test road, and second, a laboratory study of concrete durability as related to scaling.

It has not been believed that salts are the only contributory factor to scaling of concrete pavements, since scaling has been frequently observed on pavements which never had any salts applied. But detailed observations indicate that salts accelerate incipient scaling. Therefore, it is necessary to study all factors which might contribute to scaling. To this end a detailed field survey of all concrete pavements constructed on the Michigan state trunkline system was made. This survey consisted of a visual examination to determine the amount of scaling and a subsequent study of the numerous factors incidental to pavement construction which might affect surface conditions and bear a relation to scaling. The various factors studied are shown in the sample coding sheet, figure 2. The study covered about 1500 separate projects, some 290 sources of aggregates and 52 different brands of cement. Information obtained from this study assisted in setting up the various factors which should be studied in subsequent field and laboratory work. At present, the survey information is being coded and being made ready for tabulating cards for use in the standard business machine. The information obtained regarding these factors will be very interesting and should show some definite trends. The results of this study will be covered in a special report upon the completion of the work.

Soon after the completion of the field survey work, a test road project was built to assist in the further study of factors contributing to scaling as well as to study preventative measures. The construction of the test road project has been described in ROADS AND STREETS, May, 1941, issue. Briefly, the project included an evaluation of the construction factors related to scaling both as regards materials and methods of construction, such as proportioning and grading of aggregates, physical and chemical additives, cement blends, cements produced with grinding aids, curing methods, and final finishing methods.

Prior to the construction of the test road and continuing to the present, investigational laboratory work has been carried on. Results of this laboratory work assisted also in determining the set up of the test road. These and other results obtained from later studies are being correlated with the results of the field study to the end that a comprehensive evaluation of all factors can eventually be made.

Although it will be some period of time before all of the field and laboratory work is completed, it is believed a report in the nature of a progress record will be of interest to those mutually interested in the problem. *It is further hoped that such controversial issues which arise in the discussion of results will serve to incite arguments which will serve to clarify the issues as well as aid in the direction of further research activities.*

To date the following phases of the "Durability of Concrete" study have been completed.

1. Preliminary studies on aggregates, cements and additives used on the Michigan Test Road.
2. Construction observations on the Michigan Test Road.
3. First year accelerated scaling study on the Michigan Test Road.
4. Laboratory studies on "scale" from existent pavements.
5. Action of chloride salts on concrete and its constituents.
6. Laboratory freezing and thawing of specimens from the Michigan Test Road.

Each of the above phases will be discussed briefly with an attempt to bring out methods used and any findings, to date, worthy of mention and at the same time to correlate them with other phases of the durability study. *It should be understood that it is not intended there should be any finality to the findings, but rather they should be considered as indicators to what final results may be.* It is felt that in a study of this type, long range in nature, progress results are interesting although not final.

Preliminary Studies on Aggregates, Cements and Additives Used on the Michigan Test Road

After a comprehensive study of all factors pertaining to the characteristics of materials and their relation to scaling had been made, a program was set up for the determination of those characteristics which were deemed most important. This program included a study of aggregates which would be used on the test road, all of the cements available on the Michigan market and the most promising additives which had been proposed for use in correcting scaling.

From information obtained from past construction in Michigan and elsewhere, it has been held and substantially proven that over finishing and bleeding, due to characteristics of certain types of sands, aggravate scaling. Of course, both of these factors are closely related to the water content, but it is believed that the basic difficulty as regards bleeding and the necessity of over finishing can be attributed to the characteristics of the aggregate. The two most important characteristics in this connection are grading and shape of particles. As has been mentioned, water content is important but since it is a quantity which can be easily controlled, its importance was emphasized only in keeping water content as low as possible, consistent with satisfactory workability.

In designing the mixes for the Michigan test road durability section the hypothesis of "improved grading" was accepted. The improvement of grading was to aid only in the workability of the mix with a resultant reduction in particle interference. With greater workability less effort would be expended in finishing and a minimum of fines and excess water would accumulate on the surface. In the study to determine proper gradation of fine and coarse aggregate it was attempted to approach an "ideal grading" as near as possible and still be in the range of conservation as to cost and application. Only two general types of aggregates were used, namely, glacial gravel and crushed stone (coarse aggregate) and natural sand and manufactured stone sand (fine aggregate). The fine aggregate was supplemented, in some cases, with various "fines" including, limestone dust, silica dust and very fine natural sand. The approximate resulting gradations used are shown in figure 3. In some cases, the total fines passing the 200 mesh sieve, on the basis of the total mix, amounted to about 5 percent. In connection with particle shape, a study of manufactured stone sand was made as to the character of the individual particles. No attempt was made to correct what was believed to be improper shape, but the material as received from the manufacturer was accepted and observations made in the field upon the characteristics of "bleeding." This preliminary study showed the necessity of further study of this subject to the end that the slabby, angular particles of manufactured stone sand may be very undesirable as regards "scaling." It was hoped that the supplementing of the stone sand with "fines" and certain admixtures would reduce the tendency to bleeding and scaling. The results obtained will be further discussed under "First Year Accelerated Scaling Study."

In the preliminary tests, 20 brands of cement which are used in Michigan

were studied as regards to durability resistance. The tests on neat cements and mortars included freezing and thawing in water, freezing and thawing in air, action in 30 percent calcium chloride solution, with a cycle of rinsing with distilled water and drying. Studies were also made on expansion characteristics of cement mortars by use of the autoclave. The cements were rated as to their relative resistance to the various tests. Fortunately the contractor on the test road elected to use two brands of cement which showed in these tests to be widely separated in their characteristic behaviour. Further similar laboratory studies are to be made on mortars and concrete using these same cements.

Concurrent with the cement tests, studies were made on several proprietary admixtures, natural cement blends and mineral fillers. These materials included Tricosal, Plastiment, Luxment, Pozzolith, Orvus, T.D.A., Vinsol, Resin, Silica Dust, Limestone Dust, Bentonite and Fly Ash. In these studies the following tests were made on natural sand-cement mortars containing the admixtures:

1. Freezing and thawing (in water)
2. Freezing in air (saturated) and thawing (in water).

At the end of 50 cycles, in both tests, the loss in weight and reduction in compressive strength was determined. As on the cement mortars, expansion studies were also conducted on mortars containing the admixtures. From the relative results those admixtures with best resistance and physical characteristics were considered for use in the test road. However, some of these were finally eliminated because of unavailability, economic reasons and possible construction difficulties. The materials finally selected were Plastiment, Pozzolith, Orvus, Vinsol Resin, natural cement blend with and without grinding aid, silica dust, limestone dust and natural fine sand.

Construction Observations on the Michigan Test Road

In order to obtain a proper correlation and preliminary studies witn field and laboratory scaling and durability studies, it was necessary to make a comprehensive comparative study of the physical characteristics of the various concrete mixes used in the Michigan Test Road. The following factors were considered and detailed data obtained during construction:

1. Subgrade conditions, 2. General appearance of concrete, 3. Workability, 4. Segregation, 5. Consistency, 6. Bleeding, 7. Finishing, 8. Laitance, 9. Curing, 10. Appearance of concrete after removal of forms, 11. Time and temperature during placing and curing of concrete, 12. Mechanical analysis of fresh concrete, 13. Setting time of concrete, 14. Concrete test specimens for future laboratory work.

This information has been completely assembled for analysis and considerable data have been obtained for rating the various materials as regards construction practice. Such information is particularly valuable in studying peculiar conditions as well as correlating final results of laboratory and field durability studies.

First Year Accelerated Scaling Study on the Michigan Test Road

During the actual service life of the test road pavement and for a period of 3 to 5 years, it is planned to study or observe certain sections of the project under the action of ice and salts in an accelerated manner.

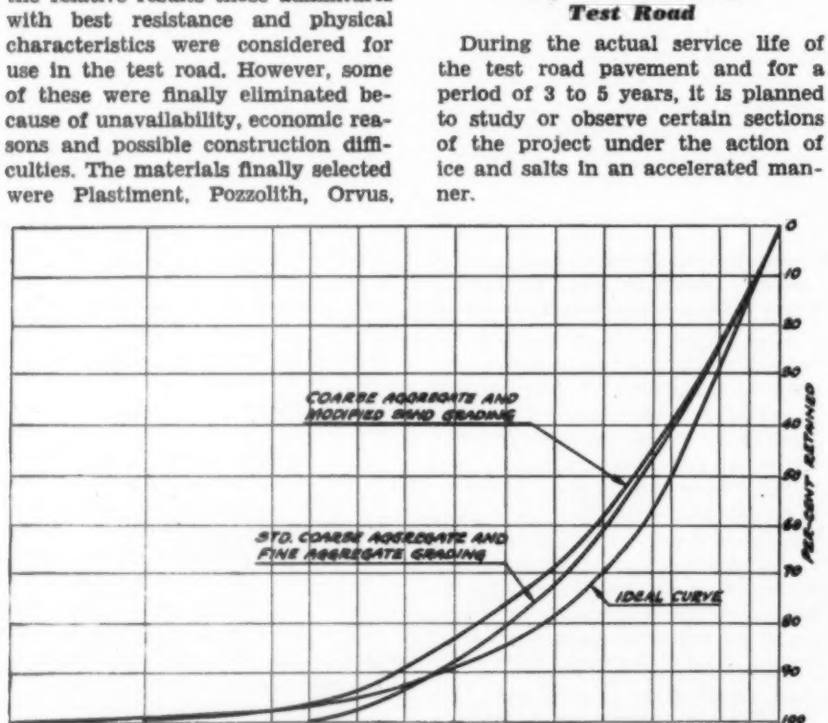


Fig. 2.—Typical Grading Curves

The correlation of the observations made during construction and actual service, together with the test information of the special scaling study, should enable the Research Division to evaluate the many factors and determine their relative importance under the conditions imposed.

In conducting the scaling study definite pavement sections 120 feet in length were chosen with respect to the various concrete mixtures and surface treatments involved in the construction of the pavement. In each section two areas were dyked off, each area being 3 feet wide and 12 feet long. The dyked areas were established along the east edge of the pavement and parallel to it, as shown in figure 4.

Two different types of accelerated test methods were employed. In test area "A," a 10 percent solution of calcium chloride of ¼ inch minimum depth was applied and allowed to remain in place 5 days. At the end of this period, the solution was removed, the panel flushed and water applied to a depth of ¼ inch. After the water had frozen, the ice was melted by an application of 5 pounds of flake calcium chloride per area. When the ice was decomposed, it was removed from the test area, the surface was flushed and allowed to rest one day before starting the next cycle. This produced a long period of contact of the concrete with the salt and introduced only a few freezing-thawing periods.

Test area "B" received a different treatment. Water was applied to the test area and allowed to freeze over night. The following morning, the ice was melted by distributing calcium chloride over the area at the rate of 5 pounds per area. When the ice was decomposed, it was removed from the test area and the freezing and thawing cycle repeated. On the basis of the quantity of water resulting from the melted ice in each test area, it was calculated that 5 pounds of flake calcium chloride would be sufficient to produce a 10 percent solution.

It is proposed to carry on these tests for several years to determine what effect age has on the ability of concrete to resist freezing, thawing and calcium chloride treatments. To this end, no calcium chloride has been applied to the durability section of the test road. Each winter the test areas will be established in the same section and adjacent to the previous test areas.

During the winter of 1940-41 a number of cycles of each "type cycle" were run on panels in sections containing each of the various materials

and methods of construction as shown in Table 1. The table shows the results obtained on the various factors for each method of accelerated action. Since the results are not final until more data are obtained, it is felt that, at this time, it is only important to show that certain of the admixtures and construction methods were beneficial in resistance to the action of salts and freezing and thawing. It is to be noted that the "B" type tests were more severe, indicating that scaling is more severe with more freezing and thawing periods. It can be said in a general way, however, that those admixtures of an organic nature which increase the air content with resultant reduction in unit weight were most effective. These results are in agreement with findings of other investigators in the field. The results of the first year's test, although very encouraging, have not warranted the acceptance of such materials on a general specification basis. In some cases, laboratory findings in freezing and thawing tests are not in agreement with findings in the field, and further, studies on the chemical action of "salts" on the constituents of concrete create certain reservations in the mind of the investigator as regards such findings. Further, it should be pointed out that some of the admixtures caused construction difficulties and delays because of poor workability, poor finishing and slow setting. Additional studies should be made in the field to determine the relative effect of the salts in the scaling action. It is proposed to make such a study during the coming winter.

In reference to the various organic admixtures which showed satisfactory resistance, it might be pointed out that in construction operations those admixtures which could be added at the mixer were more desirable. The criterion of drop in unit weight of the concrete mixture has been used for determining proper amount of material to add. The reaction of the admixture to the mixes with aggregates from different sources will vary. Therefore, those admixtures which can be controlled in quantity at the mixer should prove to be more advantageous, since no corrective measure can be taken after an admixture is ground with the cement.

The action of the admixture in the concrete is of considerable interest and the present knowledge is ably summarized by M. A. Swayze in *Concrete*, August, 1941. "The effect of air content of concrete and especially that part contributed by the organic admixtures on the physical properties of hardened concrete is a relatively new subject. It is recognized that very small quantities of these additives, such as resins, and fats, markedly increase resistance to frost action and concrete workability. They also increase air content and generally decrease strength. . . .

"Two schools of thought exist as to why these foam producing materials increase resistance to freezing and thawing. One considers the cause to be air cells themselves which furnish relief from the pressure built up by the freezing of water in concrete. The other holds that the high durability is attributable to a dispersing action in the cement gel, thus decreasing the size of capillaries in the hydrated paste. While the author is inclined toward the latter opinion, final decision must await the results of research."

Whatever the reason, it is apparent in the use of the better admixtures, workability is increased, over finishing is not necessary, water contents are kept to a minimum and there is no gravitational separation with resultant "bleeding." The elimination of these undesirable characteristics is associated with increased resistance to action of freezing and thawing and for a period of one year to the action of chloride "salts."

CEMENT	ADMIXTURE	FINISH	CURING	FREEZE-THAW CYCLES	FREEZE-THAW %SCALE	$CaCl_2$ SOLUTION CYCLES	$CaCl_2$ SOLUTION %SCALE
BRAND I	LIMESTONE AGG. & LIMESTONE DUST	BURLAP	WET STRAW	5	100.0	3	100.0
BRAND I	NONE	BURLAP	WET STRAW	13	100.0	3	100.0
BRAND I	MODIFIED SAND	BURLAP	WET STRAW	21	100.0	3	100.0
BRAND 2	NONE	BURLAP	WET STRAW	21	100.0	5	100.0
BRAND I	LIMESTONE AGG	BURLAP	WET STRAW	22	100.0	5	100.0
BRAND I	NONE	BROOM	WET STRAW	28	94.5	5	100.0
BRAND I	LIMESTONE DUST	BURLAP	WET STRAW	27	94.4	7	59.0
BRAND I	NONE	BROOM	ASP. EMULSION	25	92.0	6	22.0
BRAND I	NONE	BROOM	ASP. CUT BACK	33	83.0	7	42.0
BRAND I	SILICA DUST	BURLAP	WET STRAW	30	70.0	7	17.0
BRAND I	NONE	BURLAP	24 HR. BURLAP	27	61.0	6	42.0
BRAND I	NONE	BURLAP	WET STRAW	33	61.0	7	11.2
BRAND 2	NONE	BURLAP	WET STRAW	27	56.0	6	33.0
BRAND I	NONE	BURLAP	WET EARTH	28	33.0	6	14
BRAND I	NONE	BURLAP	PONDING	28	28.0	6	TRACE
BRAND I	TYPE # 1	BURLAP	WET STRAW	33	22.2	7	0.0
BRAND I	NONE	BURLAP	WET STRAW	27	19.0	6	6.0
BRAND I	NONE	BURLAP	$CaCl_2$ INTREGAL	24	18.7	6	TRACE
BRAND I	NONE	BURLAP	DOUBLE BURLAP	24	14.0	6	TRACE
BRAND I	NONE	BURLAP	PAPER	28	3.0	6	0.0
BRAND I	TYPE # 2	BURLAP	WET STRAW	33	1.4	7	0.0
BRAND I	TYPE # 3	BURLAP	WET STRAW	29	TRACE	7	8.0
BRAND I	NONE	BURLAP	24HR. BURLAP & PAPER	28	TRACE	28	TRACE
BRAND I	TYPE # 4	BURLAP	WET STRAW	33	TRACE	7	0.0
BRAND 2	TYPE # 5	BURLAP	WET STRAW	33	TRACE	7	TRACE
BRAND I	NONE	BURLAP	RITE-CURE	28	0.0	6	0.0
BRAND I	TYPE # 6	BURLAP	WET STRAW	33	0.0	7	TRACE
BRAND 2	TYPE # 6	BURLAP	WET STRAW	33	0.0	7	0.0
BRAND I	TYPE # 5	BURLAP	WET STRAW	33	0.0	7	0.0

Table I.—Showing Materials Used on Durability Section of Test Road

Laboratory Studies of "Scale" from Existent Pavements

Prior to the construction of the Michigan Test Road, several minor studies were made in the laboratory and field on scaled areas of concrete. Scale was collected and studied, cores were taken from the same project on scaled and unscaled areas and detailed analysis was made in comparing the characteristics of surface and parent concrete. Several microscopic and petrographic studies were made which aided in collecting information to determine what factors were related to scaling. The results of these preliminary studies showed that the cement content of the scale is 4 to 8 percent higher than the cement content of concrete underneath. As is well known, the mechanical strength of the scale was very low. These examinations indicated that the scale was the result of setting in the presence of excess water, the result of bleeding, and had been weakened by contact with calcium chloride solution.

The petrographic studies of hydrated concrete yielded information concerning only the calcium hydroxide and calcium carbonate. Definite observations on the distribution of

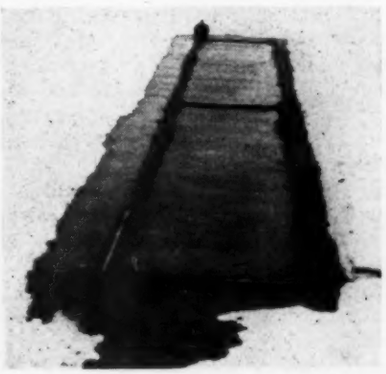


Fig. 4.—Panel Used in Scaling Studies

these products could be made and there was a definite relation between scaling and the presence of crystalline calcium hydroxide. Micrographic studies of the action of calcium chloride on mortars consisting of portland cement and Ottawa sand were interesting. Figure 5 is of a sample, "not treated" and figure 6 a sample, "treated" with calcium chloride. The effect is obvious. There has been a considerable amount of expansion with resultant fracturing and breaking out of the sand grains. Many of the cracks tend to follow the outlines of the grains and other pass beneath them appearing only when the grains are forced out and broken.

All of the preliminary studies indicated that several factors were responsible for scaling including the action of salts. It was recognized that many might be excluded by proper construction methods, closer inspection and improved specification requirements. As many as possible of these factors were eliminated in the construction of the Michigan Test Road.

In the rigid control of all factors, it is interesting to note the sections containing supplemental fines. Care was taken in the grading of the aggregates, water content was held to a minimum, workability improved, bleeding was eliminated, yet, undesirable amounts of scaling was produced in the "accelerated scaling studies." This observation led to a detailed study of the probable action of chloride salts on concrete.

Action of Chloride Salts on Concrete and Its Constituents

In the investigation of the action of chloride on concrete, the answer to "how, when and where" such action might occur was sought. Since calcium chloride was used in the accelerated studies and this salt is only used in ice control on concrete pavements in Michigan, no consideration was given to sodium chloride at this time.

In the preliminary laboratory work, it has been noted how calcium chloride acted upon portland cement-Ottawa sand mortars. If mortars could be disintegrated, the natural question is, "how does this take place?"

The rather voluminous literature available on the action of calcium chloride when added to the concrete mix before setting does not yield appreciable information on the action of calcium chloride on set cement. It is believed that the action is both physical and chemical. In further laboratory work it was found that set neat cement plates immersed in calcium chloride solutions of 20 percent to 30 percent concentration lost all coherence inside of 2 to 3 months at room temperature. Crystalline needles of calcium oxychloride grew in the liquid immediately over the material resulting from the destruction of the cement. If the calcium chloride solution was frequently submitted to temperature changes between 0°C and 35°C the crystals of oxychloride appeared even before the plates were destroyed. If freshly prepared calcium hydroxide is immersed in 30 percent calcium chloride, it appears under the microscope, at first quite amorphous. Inside of a month, especially with frequent changes in temperature needles of calcium oxychloride appear in the clear liquid and under the microscope the whole mass is found to consist of crystals of calcium oxychloride.

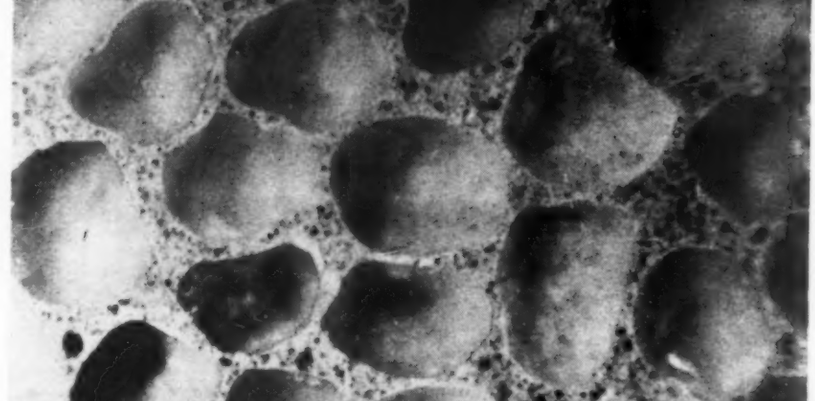


Fig. 5.—Ottawa Sand Mortar—Untreated

The conversion of amorphous calcium hydroxide into crystalline form in the scale was also noted in the petrographic studies with none apparent in the underlying concrete. The calcium hydroxide in the parent concrete was still in the amorphous state.

These observations are very interesting and indicate that scaling must be both chemical as well as physical in character.

Other investigators have noted the complete disintegration of portland cement specimens cured in saturated calcium chloride solutions. In our laboratory, plates ½ inch thick sawed out of the middle of a 6 inch core, from a 2 year old concrete pavement, were immersed in a 30 percent calcium chloride solution and in 2 to 3 months all plates suffered complete disintegration. No heating or large

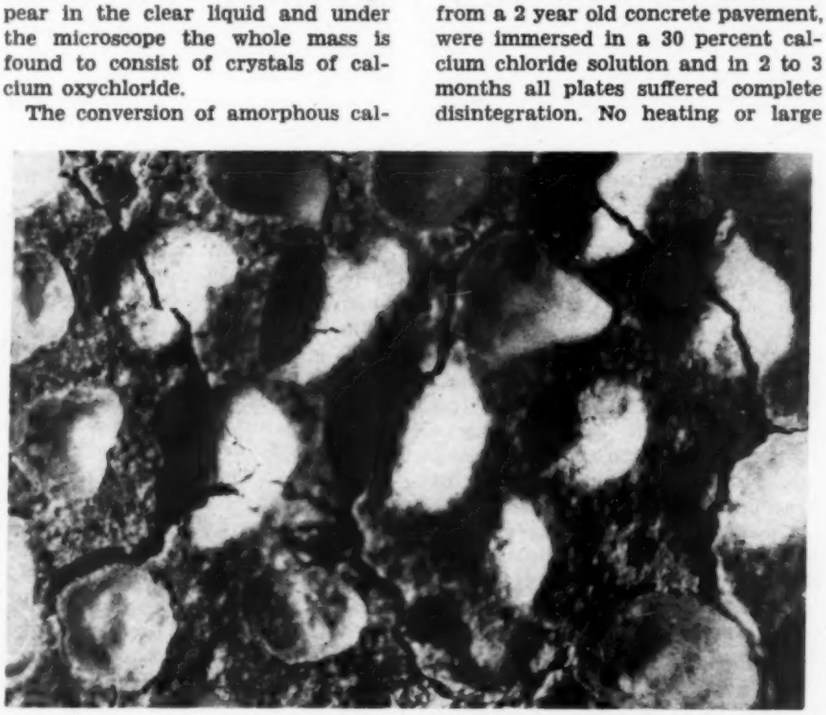


Fig. 6.—Ottawa Sand Mortar—Treated With 30 Per Cent $CaCl_2$ Solution 24 Hours

variation of temperature was employed; figure 7.

Another phase studied in the investigation was the determination of the probable concentration of calcium chloride reached on the surface of a pavement after it has been subjected to the standard treatment for ice control. Results of this study showed that concentrations as high as 40 percent could be obtained under such conditions and the depth of penetration did not exceed over ½ inch.

The study of the salt action indicates that chemical and physical action takes place particularly under conditions where concentrations reach about 30 percent. However, lower concentration down to 10 percent have reacted upon concrete at a slower rate. It is further indicated that under standard ice control treatments where approximately 1/30 to 1/20 pound of salt is applied per square yard of pavement per application, concentrations as high as 40 percent will exist.

Further study of salt action and the effect of admixtures in the reduction of scaling should aid in producing a concrete which will be completely resistant to scaling. Accelerated field and laboratory studies will assist materially in evaluating the benefits derived. However, it is felt that freezing and thawing studies in the laboratory must be supplemented with calcium chloride action.

Laboratory Freezing and Thawing of Specimens from the Michigan Test Road

During the construction of the Michigan Test Road durability section specimens for freezing and thawing studies were molded. The first series of specimens of all different concrete mixes were subjected to cycles of freezing and thawing at the age of 5 months. These specimens were cylinders 4 inches in diameter and 16 inches in length and beams 3 by 6 by 15 inches cast under field control. The specimens were placed in tight fitting rubber boots, covered with water and placed in freezer chamber containing glycerin solutions. A minimum temperature of —20°C was attained in 4½ hours, although freezing was conducted from 4 p.m. to 9 a.m. the following day. The thawing cycle was performed between 9 a.m. and 4 p.m. in a water bath at 70°F. A typical relationship of the number of cycles to change in modulus of elasticity for standard concrete is shown in figure 8.

Comparison of the laboratory freezing and thawing tests to the field accelerated scaling studies did not concrete, such as increased capillary

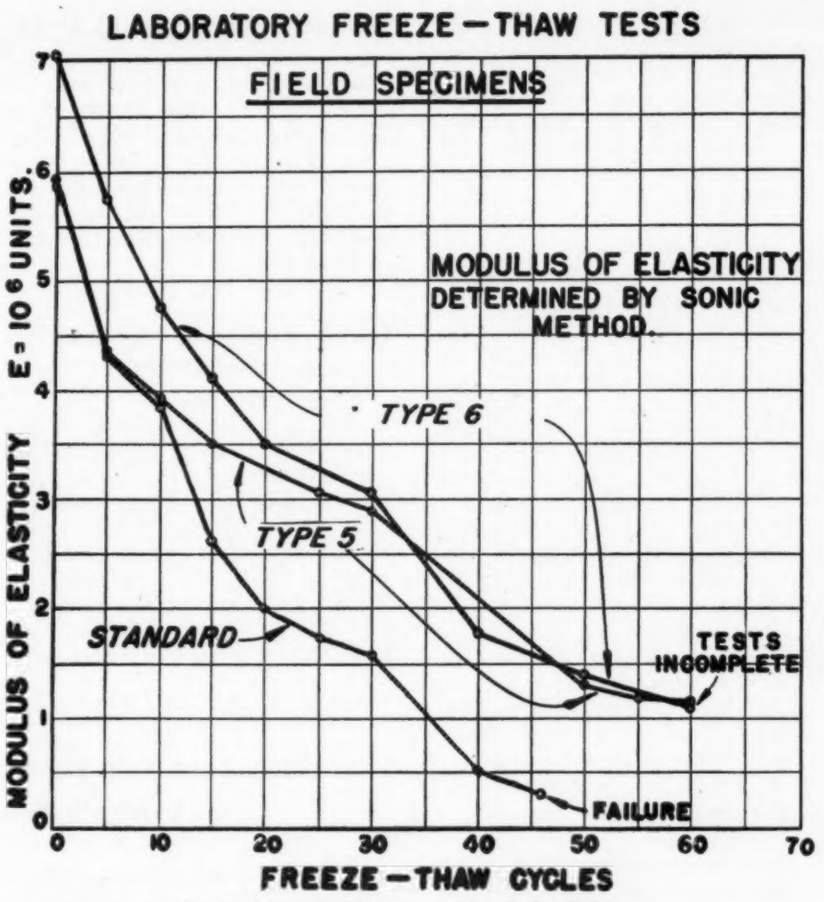


Fig. 7.—Concrete Disintegrated by $CaCl_2$ Solution

show the same relative resistance to "breakdown." However, a few significant relations were obtained. In general, those mixes which showed a greater resistance to breakdown in freezing and thawing did not scale in the field tests. It was also noted that the addition of the "fines"—silica dust, natural "fine" sands, and limestone dust—did not improve resistance when compared to normal standard mixes. And, further, the limestone dust when used both with natural coarse and fine aggregate and limestone coarse and manufactured fine aggregate, the resistance was very inferior. This might suggest that although "fines" will reduce "bleeding" in construction other characteristics are developed in the

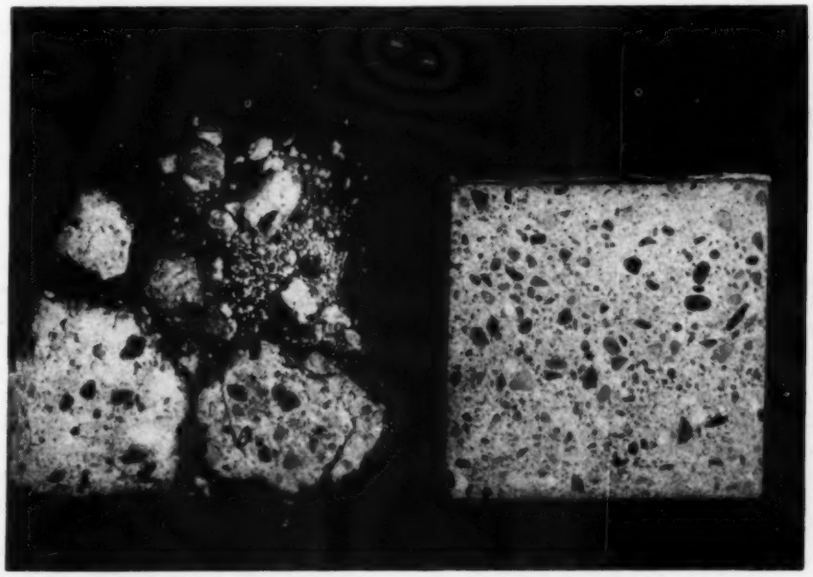


Fig. 8.—Graph Showing Effect of Freezing and Thawing of Field Specimens

attraction for liquids, either water or salt solutions. It may be possible, also, that the fine condition of the calcium carbonate with high specific surface may allow formation of other chemical compounds in combination with calcium hydroxide and calcium chloride which cause a rapid breakdown.

Conclusions

A review of the many factors which have been attributed to the cause of scaling indicates how difficult relative rating of each factor can be, since it is almost impossible to control all but one factor at a time in research investigations. Nevertheless there are certain points which have left definite impressions upon the minds of our research investigators while working on this problem up to its present stage of progress. Important among these points are the following:

1. Surface mortar scale does not appear unless certain conditions are obtained in construction and design of the mix which promote the development of a mechanically and chemically weak zone at the surface of the concrete slab.
2. Elimination of "bleeding" will not prevent action of certain chemical salts on the surface of standard portland cement concrete.
3. Increase of "fines" with cement content remaining the same does not increase resistance to scaling over a standard portland cement concrete mix.
4. Certain organic admixtures seem to increase resistance to accelerated scaling by action of calcium chloride, as well as resistance to freezing and thawing.
5. The action of certain chloride salts on concrete accelerates scaling. It is believed that this action is both chemical and physical.

Hutchison River Parkway Extension

Bit by bit the missing pieces of the metropolitan New York arterial jigsaw puzzle are being fitted into place. This booklet describes the strip of green, in that succession of massed brick, mortar, steel and wood structures, called New York, which represents the completed three and one-half mile extension of the Hutchison River Parkway from the northern part of Pelham Bay Park near the mouth of the Hutchison River to Eastern Boulevard and the Bronx-Whitestone Bridge approach.

The booklet is entirely pictures of various aspects of the extension except for an introductory statement.

Motor Fuel Usage in 1940

Motor fuel for highway use totaled 22,000,000,000 gal. in 1940 and for non-highway purposes 2,000,000,000 gal., according to state reports compiled by the Public Roads Administration. The highway use total was an increase of 6 percent over 1939, and the non-highway use an increase of 11 percent.

Grade Crossing Elimination Program

This is the title of a pictorial booklet released by the City of New York, Department of Parks, through Commissioner Robert Moses. It shows pictures, architects' sketches, and line drawings of portions of some of the railroad and street or boulevard grade crossings that have been eliminated by New York's grade crossing elimination program. A map of the New York City-Western Long Island area shows where crossings were eliminated. New York is fortunate in having a man of the calibre of Commissioner Moses to administer park, street, and highway development programs.

Boulder Highway Conference

The University of Colorado will hold its Sixteenth Highway Engineering Conference on the campus in Boulder on January 8 and 9, 1942. Major emphasis will be placed on analysis and use of planning data, city and rural zoning, intersectional design, defense highways, drainage, soils and road foundations, and problems of the contractor.

The Highway Departments of Colorado and Wyoming and the District Office of Public Roads Administration in Denver will be the chief participants.

Chemical for Prevention of Stripping of Asphalt from Aggregates

One of the defense program jobs in Connecticut, this summer, was the laying of the 20,000 - square - yard parking area at the plant of the Vought-Sikorsky Aircraft Division of the United Aircraft Corporation at Bridgeport, Connecticut. This parking area was laid with "Kotal" blacktop by C. W. Blakeslee & Sons, Inc., of New Haven from their plant at Pine Rock Quarry, Connecticut. The mix was made with trap rock ½ in. down to fines and mixed with "Kotal" and MC3 asphalt in a concrete paver. A certain percentage of quicklime is also used.

The accompanying photographs show (1) the mixing installation at the quarry (2) the aggregate feeding equipment and (3) the laying of the mix.

The Civil Aeronautics Administration, in its specifications for blacktop used in air bases, has inserted a clause calling for a waterproofing treatment on all hydrophylic aggregate. Mixing of "Kotal" is termed "water proofing."

To speed up a lagging drier attached to a hot mix plant this chemical can be used. By its use the temperature of the aggregate may be greatly reduced, thus speeding up the output of the drier to that of the mixer and reducing the oxidation of the asphalt.

Fig. 1.—Concrete mixer used for preparing aggregate with cutback asphalt

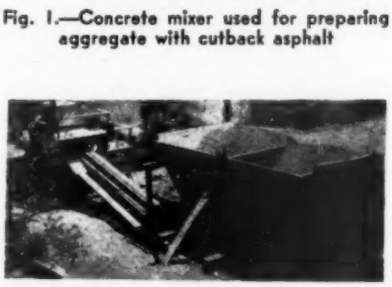


Fig. 2.—Feeding aggregates to mixer where quicklime, "Kotal" and asphalt are mixed

Fig. 3.—Spreading and rolling mixture on parking area

Discussion of a New Additional Specification for Asphaltic Road Oils

By EMIL G. SWANSON
Chief Chemist, Colorado State Highway Department

THE purpose of this article is to discuss the present status of the testing of asphaltic oils that are used in the construction of bituminous mats. An attempt will be made to present the current specifications, their development, the interpretation and sisgnificance of the various characteristics employed in these specifications, to show the inability of these specifications to yield sufficient information to afford the necessary or desired degree of evaluation, and to take advantage of this opportunity to discuss a new additional specification for asphaltic road oils that has been developed by the Materials Laboratory of the Colorado State Highway Department.

To the Asphalt Institute and the Public Roads Administration goes the credit for the specifications for the various types and grades of road oils that are in effect. Through the efforts and the cooperation of these two agencies a standardization of road oil specifications was accomplished in 1933. This standardization obviously was of great value to the producers and in turn has helped or should have helped the consumers. Such a step eliminated the necessity for the producer to continually change his refining procedure or made it unnecessary for him to carry a variety of materials on hand so that the numerous specifications could be satisfied. Recently a revision of these 1933 specifications was accomplished by the Asphalt Institute and has been approved by the Asphalt Committee of the A.A.S.H.O. This revision eliminated the overlapping of consistency requirements between adjacent grades of the three types of oils and secured greater continuity in the viscosity ratings. Under this new revision the viscosity requirements or limits are the same for each grade of all three types of oils; this means that the viscosity limits are the same for an SC-3 as for an RC-3 or an MC-3. This revision also embraced a change in the method of expressing the results obtained from the distillation test on the RC and MC types of oils whereby the fractions of distillate obtained in the various temperatures employed in the distillation test are expressed as a percentage of the total distillate instead of as a percent of the original oil. This method yields more information regarding the volatility of the solvents employed in the RC and MC types of cut-back oils.

Chemical laboratory of Colorado State Highway Department

The Asphalt Institute is sponsored by various oil companies for promoting the use of bituminous materials and it is only natural that their interest in the specifications are essentially those of the producer. The Public Roads Administration participates in the cost of oiling programs and naturally is interested in the quality of the materials used in construction. As a unit of the federal government it is its duty to investigate the merits of all specifications in which it participates so as to avoid those that may have been designed for outright discrimination. We have specifications designed or agreed upon by two agencies: One, the Asphalt Institute whose primary interest is the interest of the producer; two, the Public Roads Administration which tends to be lenient as exemplified by so many other government specifications.

Interpretation of Tests

In presenting the interpretations and the significance of the individual characteristics that are contained in the specifications, methods and details are purposely omitted, for those are laboratory problems.

Specific Gravity.—The gravity of liquid asphaltic products is of little significance as an index of the quality or usefulness of a finished product and therefore does not appear in the specifications. However, petroleum products are sold on the basis of volumes delivered at 60°F. The gravity of these products must be determined wherever volume corrections are to be made or if a conversion from a volume to a weight basis is desired. There are two scales in general use in the petroleum industry, the specific gravity scale and the A.P.I. scale. The A.P.I. scale is so designed that the lower the specific gravity the higher the A.P.I. value.

Flash Point.—The flash point of a material indicates the temperature at which it may become a fire hazard but bears no relation to quality. It may also serve to identify the type of material. Although the closed cup tester is preferred to the open cup tester for determining the fire hazard, the open cup is used on bituminous materials and the results are sufficiently accurate for practical requirements. If the flash point of an RC cut-back oil is 100°F., then at a temperature of 100°F., or above the material may constitute a fire hazard and should be handled accordingly.

Moisture.—The new specifications adopted by the Asphalt Institute states that the RC's, MC's and SC-2 to 6, inclusive shall be free from water. Previously a water and sediment value of not more than two per cent was specified. This revision is very desirable because as low as one-half of one per cent of finely dispersed water may cause a great deal of foaming. Some have experienced the loss of overly large quantities of oil due to "boiling over" during the process of heating prior to unloading. This free from water specification can hardly be interpreted as a quality test because it controls the presence of water and reveals no information concerning the oil itself.

Viscosity.—The viscosity of a material when determined at just one temperature is a measure of the re-

Bituminous laboratory of the Colorado State Highway Department

Apparatus used for filtrations involved in procedure for determining Viscosity Index of the oily constituents of asphaltic road oils. A—500cc fretted glass filter funnel and 2 liter vacuum flask showing both the asphaltene and malthene fractions. B—Setup and receiver used for the final filtration of the oily constituents. C—No. 4a Buchner funnel and 4 liter vacuum flask containing petroleum ether solution of the oily constituents. Spent Fuller's earth and adsorbed resins retained on No. 0 Manktell filter paper

sistance of that material to continuous deformation at that temperature. It is a measure of the consistency or the property that is commonly referred to as "body." A viscous material will therefore have a higher viscosity than a fluid one. The new specifications for an SC-3 specify limits similar to the old CS-4 grade with which some of you are familiar. The limits for the viscosity range of the new SC-3 oil is 250-500 seconds at 140°F., aas compared to limits of 350-550 seconds for the oil SC-4. It should be stated at this point that the Colorado Highway Department has adopted the new specifications for the RC and MC oils but has not adopted the new SC specifications. Whether or not the new SC-3 material would prove to be too viscous for road mixing under our conditions would have to be determined, but we feel that the new SC-2 grade is too light for our main type of construction. It is obvious that the use of viscosity limits enables us to specify only the grade that is desired and that it reveals nothing about quality.

Distillation.—By subjecting a road oil to a standard distillation test it is possible to separate the volatile solvents from the semi-solid asphalt, thus taking apart for test purposes what the refinery has blended together. The results from the distillation determines whether the flux or solvent is a naphtha as in the RC's or kerosene as in the MC's. From the percentages distilled off at various temperatures it is possible to judge how rapidly the cut-back will cure or it will indicate its "setting" characteristics. The merit of the distillation test lies in the fact that it enables us to identify the type of material, but it also yields no information as to quality.

The consistency of the semi-solid residue from the distillation test varies according to the type of oil and therefore it is desirable to measure the consistency as a means of identification. The residue obtained from the distillation of an SC oil may be too viscous for a Saybolt viscosity and too soft or fluid for a penetration test. The float test is therefore applied to distillation residues from SC oils and the consistency measured in this manner serves as an index of the stability that the material will impart to the mat due to the cohesion of the asphalt itself. The residues obtained from the distillation of the RC and MC oils are of a solid to semi-solid nature, and the consistency of these is measured

Distillation apparatus for recovering oily constituents from solution in petroleum ether

by the penetration test. The penetration value is a number which indicates the distance in hundredths of a centimeter that a standard needle, under standard conditions of load, time, and temperature will penetrate into the residue in question. The new specifications for the RC and MC oils have a higher minimum value for penetration of the distillation residues which represents the trend toward sfter asphalts in an attempt to alleviate permature hardening. The minimum value of 60 for the RC residues has been raised to 80 and the minimum value of 100 for MC residues has been raised to 120. You can see that the penetration and the float are consistency tests that also serve as a means of identification but do not serve as an index to quality.

Ductility.—Both the old and the new specifications for all three types of oils require a ductility of 100 centimeters at 77°F. The ductility is determined on the residue from distillation of the RC and MC oils. The SC oils are reduced to 80 penetration by heating at a temperature of 485°F., until the desired consistency is obtained and the ductility is then determined on this 80 penetration residue. The reduction of an SC oil to 80 penetration represents the method of determining asphalt content in SC oils and is expressed as a percentage of 80 penetration residue on the basis of the original oil. The new specifications for an SC-3 have a minimum of 70 per cent of 100 penetration as compared to the old specification value of a minimum of 65 per cent of 80 penetration asphalt. It is generally agreed that a high ductility is especially desirable because it indicates that the material possesses the capacity for deformation or extension without rupture, a property due to adequate cohesion. However, the test is not quantitaitve to the desired degree but only shows the presence or almost complete absence of this property. Low temperature ductilities are determined by stretching a standard briquette of a material at a rate of 5 centimeters per minute at a temperature of 39.2°F., instead of 77°F. This test is intended to serve as guide in determining whether or not the residue may become brittle in service at low temperatures. The Public Roads Administration is not in favor of this low temperature ductility test.

Solubility.—The elimination of the solubility test in carbon disulfide in

A—SC3 residue, 125 grams. B—Actual yield of asphaltene fraction from A. C—Actual yield of oily constituents from A. D—Example of a "waxy" oily phase. E—Constant temperature bath and Fenske-Ostwald pipettes for kinematic viscosity determinations

the new specifications is justified because this test is an old test carried over from the native asphalt days when various amounts of inorganic matter were carried along in permanent suspension in the natural asphalts. The per cent soluble in carbon disulfied represents the per cent of total bitumen, the difference indicating the amount of foreign material contained in the sample. A solubility test in carbon tetrachloride is incorporated in both the old and new specifications for a twofold purpose.—First, it supplements the carbon disulfide solubility and also shows the presence of carbenes, a constituent resulting from over-heating or cracking. In this manner both inorganic materials and carbenes are obtained as insoluble materials in this solvent.

Spot Test.—The Oliensis spot test is used to differentiate between cracked and uncracked products. The fact that some crudes and some oils that possessed good service records and are known not to have been cracked due to excessive temperatures during refining but sill showed positive spot tests led to a modification of this test. The xylene equivalent method enables a quantitative determination of the relative degree of heterogeneity. In this method the Oliensis solvent or normal heptene is partially replaced by various percentages of xylene which greatly improves the solvent property of the straight solvent. Therefore, if an oil yields a spot with a solution of 90 per cent heptane and 10 per cent xylene but shows no spot with a 15 per cent xylene solution, the material is said to have a 15 xylene equivalent. The spot, of course, is due to the presence of constituents insoluble in the solvent or solvent mixture.

Asphalt Quality Evaluation

Now that the various characteristics have been discussed and if I haven't failed too badly in the interpretation of their significance, it will be seen that each one has a definite purpose or function in the specifications. We have three types of road oils; the rapid, medium, and slow curing, each designed for a definite type of construction. By employing the above specifications it is possible to designate the grade and type of oil desired. However, you can also see that these characteristics do not and cannot yield sufficient information regarding the oil to afford the desired degree of evaluation. The use of these specifications alone affords practically no control over quality and makes it impossible for the laboratory to determine which oil in terms of dollars and cents is the most desirable. If we were fortunate enough to have quality tests at our disposal we would be able to tell in advance whether or not a somewhat higher priced oil would actually be a better buy than an oil offered to us at a lower figure, both of which will meet all of the characteristics employed in the current specifications. The fact that the consumer is badly in need of ways and means of determining quality may be shown in many ways. First, oils that meet these specifications have service records ranging all the way from bad to good. Second, oils have been submitted to our laboratory from all parts of the country, all of which easily meet the foregoing specifications, and yet, in our opinion, it is ridiculous to assume that some oils are of the same quality as the highly asphaltic oils from other sources just because they both meet specifications. As a matter of fact, I believe that we could not afford to accept some oils, even though they meet specifications, if they were to be supplied free of charge to the Highway Department. Third, the fact that the consumers are of the solid opinion that quality tests are badly needed is exemplified by the continuous search for means of solving this very complex problem. Whether it is Cambell's oxidation test, Benson's film test, Zapata's fluidity factor, or our own Viscosity Index test, they all prove that a great deal of time and effort is being spent in attacking this problem of evaluating asphaltic road oils on a quality basis. I doubt if this complex problem will ever be completely solved by a consumer's laboratory. The solution to it can only come from an organization where salaries commensurate with the abilities and capacities of expert physical and organic chemists are in effect. We as consumers look to the Asphalt Institute and the large research laboratories of the outstanding producers for assistance in this problem, but for obvious reasons we know that even if this information is existent, and we feel that it is, that it will not be available to consumers and that we are looking in vain.

Now the legitimate question: What do we mean by quality? It may be defined as the sum total of all the properties that yield a material that results in the longest useful life per unit cost. It embraces such properties as ease of application, the rapidity and tenacity with which it costs and adheres to the aggregate, its resistance to rupture, cracking or the ability to withstand deformation without failure. It also embraces the ability to retain its original characteristsics, to resist stripping, weathering, and hardening.

Viscosity Index of Oil.—In connection with this subject I would like to discuss lubricating oil, the reason for a few words on this subject will soon be apparent. It is obvious and quite natural that lubricating oil has been the subject of a tremendous amount of research due to its importance in our daily life. This research has resulted in an excellent way of evaluating and classifying the various types of lubricating oils. It is the consensus of opinion that a good lubricating oil should have satisfactory viscosity temperature characteristics which means that the oil shall not thin excessively at elevated crankcase temperatures and shall not thicken or become extremely viscous at low temperatures.

We know that the paraffin type Pennsylvania oils or the solvent refined oils that show paraffin characteristics posses a low viscosity temperature susceptibility while the asphaltic type of lubricating oils possess a high viscosity temperature susceptibility and for this reason along with the chemical instability are the least desirable for the lubrication of the internal gasoline combustion motor. Now there has been developed a method of expressing this viscosity-temperature susceptibility by determining the viscosity of the oil in question at two temperatures, at 100°F., and 210°F., and expressing the rate of change in round numbers by a value called the Viscosity Index. In other words, the viscosity index is a number which indicates the relative tendency of the oil to change viscosity with increasing or decreasing temperatures and in turn represents the inherent, constitutive property of oil, indicating its type, from asphaltic to paraffinic The data necessary for calculating the V. I. was published by Dean and Davis of the Standard Oil Development Company in 1930 and immediately won wide-spread approval because of its ability to express in round numbers and in black and white just how asphaltic or paraffinic an oil may be. In passing I will say that the V. I. is an empirical relationship based on the viscosity temperature susceptibility of two typical types of oils. A conventionally refined Pennsylvania oil has been arbitrarily assigned a V. I. of 100 and the conventionally refined asphaltic oil a V. I. of zero. It is admitted that the V. I. scale has no theoretical foundation, but other proposed me-

thods of measuring this rate of change that indicate whether it is asphaltic or paraffinic have no distinct advantage over this empirical method of classification, while the simplicity and convenience of the viscosity index concept has favored its wide adoption by the petroleum industry. I have devoted this time in an effort to impress you with the significance of the viscosity index value. It is nothing new, but the use of this well established test to express just how asphaltic the lubricating oil fraction of a bitumen may be is a new application of this accepted method.

Phase Separation As Asphalt Evaluation Tool

In the book "Asphalts and Allied Substances" by Abraham there is a chapter devoted to the analysis of asphaltic constituents in which the procedure is given whereby the constituents of an asphalt may be uantitatively divided into three groups.

These three groups of constituents are called asphaltenes, asphaltic resins and oily constituents. The oily constituents so obtained by this method of selective solvent action and preferential absorption are identical with the lubricating oil fractions with with you are all familiar. I would also like to quote a paragraph taken from the above mentioned chapter: "The value and possibilities of these determinations do not appear to be generally appreciated, but as time goes on they will certainly be recognized." It was this statement that prompted the investigation that has resulted in the new additional specifications for our asphaltic road oils which states that the viscosity index of the oily phase constituents shall be not more than 70. In separating a bitumen into these three groups of constituents the residue from distillation is employed because the material distilling abovee 680°F., remains, or is supposed to remain, as a permanent part of the mat in which the oil is incorporated while the material distilling below 680°F., is supposed to volatilize and be lost. The purpose of the lighter low boiling solvents is only to reduce the material to the desired consistency and due to evaporation does not remain to serve in any capacity in the finished mat.

Viscosity Index of Oily Phase.—It is only the fact that these three groups of constituents can be separated and determined quantitatively that makes the application of the viscosity index to the lubricating oil fraction possible. While this is not absolutely true from an analytical chemist's definition of a quantitative analysis due to the fact that there is no absolutely true dividing line between asphaltenes and resins, and resins and oily constituents, many determinations have been made in our laboratory to prove that the dividing lines between these three groups of constituents are narrow enough to yield results that are commensurate with the interpretation of the V.I. value.

Laboratory Separation Procedure. —In using this method of phase separation as a new tool in attacking the problem of road oil evaluation, a quantity of the residue is dispersed in 88° Baume naptha. This solvent dissolves two of the groups, the oily constituents and the asphaltic resins, while the asphaltenes are depeptized and precipitated. A simple filtration removes the precipitated asphaltenes. The filtrate containing the resins and the oily constituents is treated with an excess amount of Fuller's earth that absorbs the resins but does not affect the lubricating oil constituents. The earth with its absorbed resins is then removed by another simple filtration. All that remains to obtain the oily phase constituents is to distill the solution so as to completely remove the naptha medium in which the lubricating oil is dissolved. The essence of the whole test is that we remove the lubricating oil from an asphalt and then determine how asphaltic or paraffinic it is by determining its viscosity index just as we would analyze or classify a commercial lubricating oil. The above procedure appears quite simple, but I assure you that a great deal of time and effort has been expended on developing a simple, practical technique that yields reliable results. Now the question might be asked—Why go to the trouble of removing the lubricating oil fraction, why not work on the original oil? Asphalts are colloidal and colloidal materials may exhibit an erratic viscosity temperature susceptibility. The consistency of the original oil may be such that we do not have means of accurately measuring the viscosity of the material at different temperatures, and if we could obtain accurate determinations we do not have a method of interpreting the obtained susceptibility because the V.I. data were designed for use only on lubricating oil fractions.

Conclusion

In conclusion, I wish to state what we feel is accomplished by the use of a maximum V.I. value of the oily phase constituents, in our specifications. You will agree that ten years of experience during which time the Colorado State Highway Department has used approximately 100,000,000 gallons of road oils from various sources has enabled us to form opinions of these various oils. Up to the time that we began to use this viscosity index method of evaluating oils we were unable to discern any expressible difference between these various oils because they all met the specifications that were in effect. When the viscosity index was determined on these oils with which we have had experience there immediately appeared a most gratifying correlation between the service record of these oils and the V.I. values obtained. [See editorial in this issue —Editor.]

Use of Viscosity Index. — In our specifications for liquid asphaltic road materials we state that the various oils shall be the products of an asphaltic base crude. Now how asphaltic is an asphaltic crude? That may sound like a peculiar question, but it is just as legitimate as the question, how white is white? By the use of this viscosity index specification we are able to define just how asphaltic the products must be which in turn defines how asphaltic the crude must be from which these products are made. This ability to define how asphaltic the products must be justifies the use of this specification if for no other reason.

The maximum V.I. value eliminates waxy or mixed base crudes and yields the information that was desired of the wax test that was designed to show the presence of paraffin constituents. The wax test has been deleted from specifications because it failed to indicate whether the material was semi-paraffinic or asphaltic. It was capable of determining only the solid paraffins known as paraffin scale. The presence of an appreciable amount of scale was to serve as an index as to the type of oil, but it is possible to have a highly paraffinic oil that contains or shows no scale and for this reason the test has been dropped. To go to one extreme, and of coures it's ridiculous, everyone knows that an oiled road cannot be made with Pennsylvania oil. It is quite logical then that a method of telling how close we are approaching the other extreme, the highly asphaltic oils, would be desirable because when we purchase asphalts we want asphaltic materials and not a mixture of waxy or par-

affinic materials along with the asphaltic constituents.

The most important reason for controlling the paraffinicity of the oily phase or the dispersing medium by a maximum V.I. value is that we thereby obtain oils that have a high degree of dispersion of the asphalt colloids. It is assumed that the asphaltenes are colloidally dispersed through the protective colloidal action of the lyophilic resins all of which are highly dispersed in the oily phase medium. Now we know that the low V.I. or napthenic type of oils are more polar and therefore can disperse the asphaltic colloids to a higher degree because of a more intense peptizing action which results in a material of higher plasticity, if we define plasticity as that property which enables a material to be permanently deformed without rupture under the application of pressure. In the construction of a semi-rigid type of pavement it is imperative to employ a binder that has a high degree of plasticity so that it may be capable of withstanding strain. A brittle binder if subjected to a stress that produces even a small strain may fracture and cause the material to lose its coherence.

We believe, also, that there is a a correlation between the quality of the asphaltene-asphaltic resin fraction and the V.I. of the oily phase constituent on straight run products. This assumption has been made from observations of materials in service. We have, however, recombined the asphaltenes and the benzol soluble resins and have found that the higher the V.I. of the removed oily phase the more brittle is the combination of the asphaltene-benzol soluble resin fraction. At present we are engaged in finding means of completely removing, without chemical attack, the absorbed resins so that distensibility values can be determined on the asphaltene-resin fraction.

We realize that the oily phase constituents of an SC-3, and that is the type and grade in which we are primarily interested at the present time, represents only 60 to 70 per cent by volume of the oil, and that is one reason we do not claim that this specification is the Utopia of asphalt specifications. We are also well aware of the fact that the asphaltic resins and the constituents called asphaltenes are perhaps the most important fractions of a bitumen and that it would be impossible to construct a bituminous mat with the use of a low V.I. lubricating oil alone. However, for the above reasons we feel that for the present we are justified in using this method as an index of the quality of these two other groups that we know so little about.

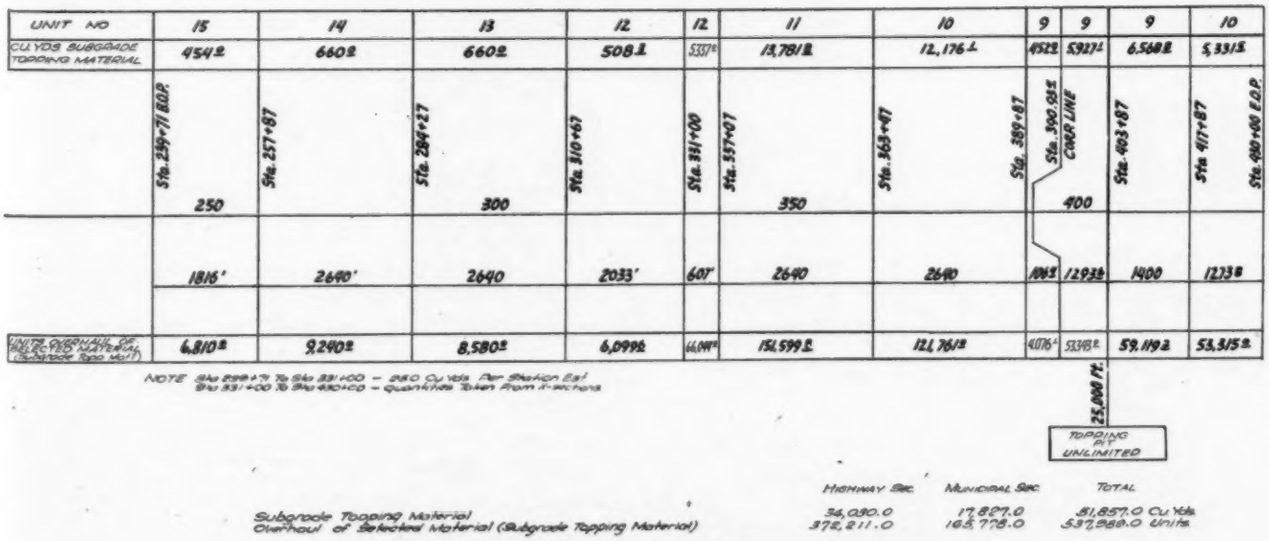
I know of very few tests that are capable of yielding all the information that may be desired of a given material. An ore may be submitted for a gold assay, but if the smelter imposes a penalty for zinc then a zinc determination must be also made before the actual value of the gold content can be obtained; and so it is with the viscosity index test. The fact that cracking will lower the V.I. value makes it necessary to rely on the Oliensis method of determining if cracking has taken place. However, we feel that this method has given us a new approach, and will play an important part in the solution of this complex problem of evaluating asphaltic oils for bituminous construction purposes.

Overhaul Chart

Overhaul of Subgrade Topping Material, under the 1934 Mississippi State Highway Department's specifications, is based on free haul of a half-mile, or 2640 feet, from the point of origin, and overhaul beyond the half-mile limit. The point of origin is the center of volume of material in the cut, the pit or the midpoint of the railroad team track or similar delivery point. From the point of origin in the direction of movement along the shortest practicable route, zones of one-half mile are laid off. The first half mile constitutes the free haul zone and no overhaul is paid on material deposited within this zone. Each succeeding half mile zone outside of the free haul zone is numbered consecutively beginning with number one. For each cubic yard of material deposited within each zone there are allowed the number of cubic yard — half mile overhaul units indicated by the corresponding zone number. Under the Mississippi State Highway Department's specifications adopted in 1940, the method of computing overhaul of selected topping material is the same except that there is no free haul and the numbering of the zones begins with the first zone from the point of origin.

On the attached overhaul chart, which was prepared under the 1934 specifications, the center of volume of the pit is 25,000 feet from the center of the roadway at Station 403 — 87. Nine half-mile zones, one of which is free haul, leave 1,240 feet in the ninth overhaul unit before reaching the center line of roadway. Therefore, the ninth zone extends in both directions from Station 403 —

(*Continued on page* 41)



NOTE Sta 239+71 To Sta 331+00 – 250 Cu Yds Per Station Est
Sta 331+00 To Sta 430+00 – Quantities Taken From Profiles

	Highway Sec.	Municipal Sec.	Total
Subgrade Topping Material	36,090.0	17,827.0	81,857.0 Cu Yds
Overhaul of Selected Material (Subgrade Topping Material)	372,211.0	165,778.0	537,989.0 Units

Mississippi Overhaul Chart for Gravel Topping on Route 80

Scrapers and Power Shovels Cooperate on Connecticut Job

Pusher-Loaded Scrapers for Short Hauls of Earth; Shovels and Trucks for Long Hauls and Rock

CONSTRUCTION of an 8,089-ft. section of the Wilbur Cross Parkway by D. Arrigoni, contractor of Middletown, Connecticut, was completed on a close calendar day contract in the amount of $330,-439.25. The job includes three major cuts; three major fills; the relocation of Connecticut State Route 32 for a little more than 2,000 feet; a 93-ft. skew span deck girder overpass bridge to carry the Parkway over Route 32; almost 1,700 feet of approaches connecting the two roads; and a heavy reinforced concrete triple box culvert. Concrete paving is to be done at some future date, only a 4 in. rolled gravel surface 22 ft. wide being laid by Arrigoni. The relocated Route 32, however, is being paved with bituminous macadam over a heavy gravel sub-base course.

Arrigoni contracted to handle the estimated 415,373 cu. yds. of unclassified excavation for 19c per cu. yd., and the estimated 65,829 cu. yds. of borrow for 18c per cu. yd. A total of more than 500,000 cu. yds. had been excavated.

The three major cuts, shown on the sketch profile, Figure 1, actually contained (in round figures) about 90,000 cu. yds. for the cut marked "6," of which 5,000 cu. yds. were rock and 85,000 cu. yds. earth; about 180,000 cu. yds. for the cut marked "4," of which practically all was earth, hard clay and boulders; and about 180,000 cu. yds. for the cut marked "2," of which 20,000 cu. yds. were rock and 160,000 cu. yds. earth.

There was plenty of material in cuts for fill "5," but fills "3" and "1" required the use of borrow. Fill "1" took more than 200,000 cu. yds. to bring the Wilbur Cross Parkway up to the proper level and to provide ramps for the connecting approach roads.

Arrigoni, who owns considerable excavating equipment, had his choice between using carryall scrapers or power shovels for the earth excavation. Where ledge rock was present, as in two of the cuts ("6" and "2"), there was no question about the need for power shovels. But there still remained the question of how best to handle the remaining 425,000 cu. yds. of earth, clay and boulders.

Principal Equipment and Output

Equipment available consisted of 2 Bucyrus-Erie shovels, a 2-yd. and a 1¼ yd., with ten 5-yd. Mack, Sterling, and Linn trucks in one outfit and 2 model W LeTourneau scrapers pulled by D-8 Caterpillar tractors (pusher-loaded downgrade). Inspection of the earth disclosed the probability of large percentages of hard clay, which would require the use of a rooter unit.

The shovels were available for rock excavation and also for the long haul loading. The distances from the easterly ends of cuts "4" and "2" to the westerly ends of fills "3" and "1" were

Fig. 2.—Grade separation carrying Wilbur Cross Parkway over State Route 32

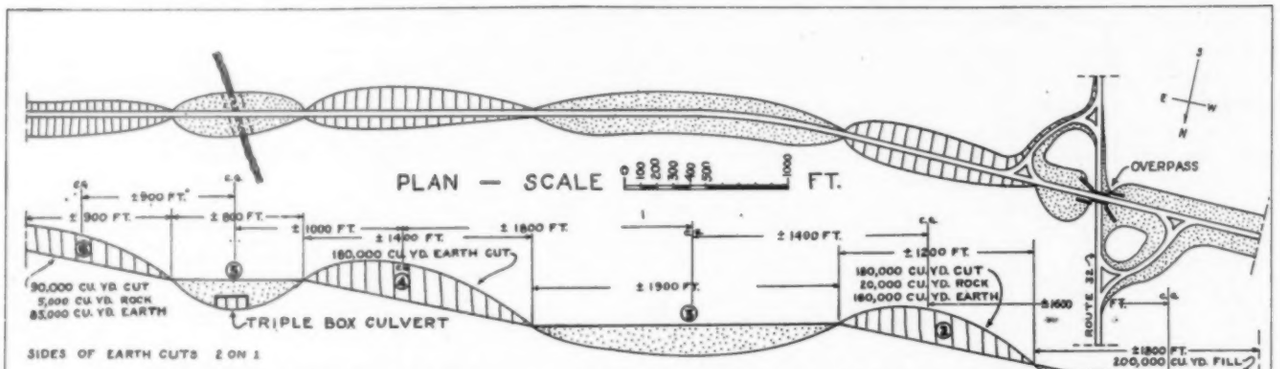


Fig. 1.—Plan and profile sketches of Contractor Arrigoni's job on the Wilbur Cross Parkway near West Wilmington, Connecticut

Fig. 3.—Two-yard shovel loading five-yard truck in cut "6" in which boulders occurred in large quantities. The truck-shovel combination was used for the long hauls

3,300 feet and 3,000 feet, respectively, which were greater than Arrigoni considered economical for scraper-tractor operation. So he decided to use the two scrapers, pulled by crawler tractors and pusher-loaded with another D-8 tractor on which was mounted a LeTourneau bulldozer for the shorter hauls. With the scrapers he excavated until the one-way haul was 1,200 feet, the only longer hauls being up to 1,750 feet for short periods when it was a case of making the hauls or laying off the scrapers.

The scrapers, on the 1,200-foot one-way hauls, made a daily average of 5.25 round trips per hour, each hauling about 95 cubic yards of loose earth per hour and 85 cubic yards of rooted clay per hour. Pusher-loading was done on downgrades which varied from 4 per cent to 10 per cent. Loading distance varied from 100 to 120 feet, depending on whether or not the clay had been freshly rooted. About two hours rooting per day was sufficient to provide more than a day's work for the two scrapers.

Saving Time.—On the scrapers and rooter preformed wire rope was used because of trouble previously caused by non-preformed, particularly in the tailgate forward cables for the first 20 or 25 feet of the power unit end of the cable. This portion is subjected to severe service around the drum and over the sheaves of the power control unit. The reeving of ½ in., 6 by 19, preformed, Lang-lay, improved, plow steel, wire rope with independent wire rope center solved this problem completely. A storage drum carried a considerable length of surplus cable which was unclamped at the dead end, unreeled through the sheave system to enable any worn length of cable at the power unit end to be cut off, and then reclamped. This also resulted in shifting wear points and increasing cable life by distributing cable wear more uniformly over the entire cable.

At 18.6c per foot, a trifle more than the cost of non-preformed, the preformed lasted approximately 2½ times longer. According to the contractor, however, this saving was a minor one compared to the very considerable elimination of idle time for cable changes or replacements. Cable breakage occurs when the scraper or rooter is busy and repairs cannot very well be postponed until a more convenient time. According to the operators there was less than half the cable breakage or need for cable shifting after preformed was used.

Disposition of Equipment.— While the scrapers and the rooter were handling the shortest hauls possible, the two shovels were busy with the rock and on some sections where the earth was so full of boulders as to be practically unplowable. The trucks working under the shovels hauled their loads whenever possible to the farthest point of the fill. For instance, from a shovel working in cut "2" the trucks would haul to the extreme westerly end of fill "1"; the same with cut "4" and fill "3," and cut "6" and fill "5." The reason for this is, of course, due to the fact that the length of truck haul has much less effect in raising yardage costs than has a long scraper haul.

Output.—The 2-yd shovel loaded out about 1,500 cubic yards and the 1½-yd. shovel about 1,000 cubic yards in a 7-hour shift. Both could have done much better had there been more than 6 five-yard Mack and Sterling trucks and 4 five-yard Linns on the job. Average truck haul was about 1,800 feet from cuts "2" and "4." Each truck hauled about 37 cubic yards an hour.

Hauling conditions were fair to good except on fill "3," which was rather soft in spots where a stream was crossed. Except at fill "5," a truck hauling road roughly paralleled the fill area. All movement of material was downhill to the west, the general slope being downward in that direction.

Fig. 4.—Looking east from fill "1" after work had been in progress for about three months. At left is pile driver working on steel piles for overpass. Protruding upper ends of piles are visible in center. These ends are later cut off to proper length with oxy-acetylene torch. Cut "2" is at left behind mast of pile driver and a dump truck is visible at right of pile driver, entering the cut after dumping its load on fill "1." At the right an RD-6 Caterpillar tractor with LaPlant-Choate bulldozer is rough grading earth the truck has just dumped. At extreme right is the cab of an old Erie steam shovel. Above tractor are Blaw-Knox aggregate and cement storage bins. At right center, above protruding piles is 27E Ransome concrete mixer. At left of bins is tank truck of Valley Oil Co., which is coming down out of cut "2" after servicing equipment there. It is just entering Route 32 which had not yet been re-located to run where the piles are being driven. So far, none of the earth on fill "1" has been carried there by the scrapers. It is all long distance truck hauled

Fig. 6.—Diesel motorgrader dressing up fill "3." Cut "4" in back of grader

About half of cut "6" was done with scrapers; two-thirds of cut "4" and four-ninths of cut "2," according to Anthony L. Arrigoni, General Superintendent of the job. He reported that the combination of shovel-truck and scraper-tractor excavating method, based on giving the long hauls to the trucks and the short hauls to the scrapers, was entirely satisfactory.

Other Equipment and Materials.—Other equipment on the job included a steam hammer with which nearly 400 steel H-beam bearing piles for the overpass were driven; two RD-6 Caterpillar tractors and one RD-4 Caterpillar tractor, all equipped with LaPlant-Choate bulldozers and used for rough grading; a No. 12 Caterpillar Diesel motorgrader for fine grading; four 35-ton Blaw-Knox aggregate and cement bins and a 27E Ransome concrete mixer, the latter used primarily to mix the 5,236 cubic yards of class A concrete for the overpass piers and wing walls.

Carnegie Steel Company furnished the steel bearing piles and the deformed steel reinforcing bars for the concrete structures. American Bridge Company supplied the structural steel for the deck girder overpass.

Personnel.—The job is a Federal Aid project and was built according to the designs and under the supervision of the Connecticut State Highway Department. Dudley Kiely was Senior Engineering Aid in charge for the department of which William J. Cox is State Highway Commissioner. Anthony Arrigoni was General Superintendent; Robert Scussel, Assistant Superintendent, and Ernest Malcarne, Bridge Superintendent.

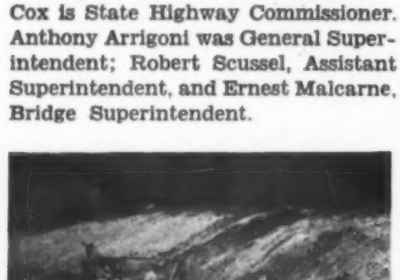


Fig. 7.—Tractor, with bulldozer mounted, pulling rooter in cut "4"

Fig. 5.—Two scrapers towed by tractors coming down a 6 per cent grade out of cut "4." Road at extreme right to right center is the truck haul road from shovel, which is working (at time photo was taken) at eastern end of cut, while trucks were dumping at extreme western end of fill "3." Scrapers were dumping as near eastern end of fill "3" as possible to make hauls short

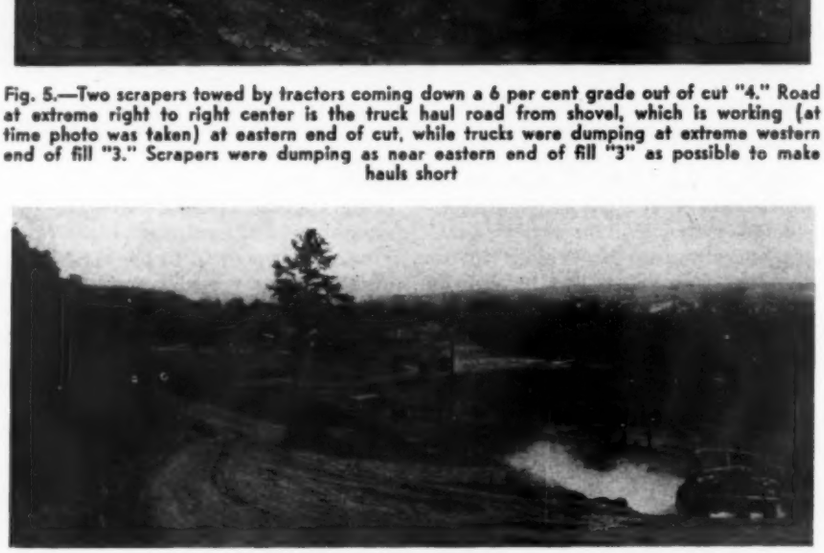


Fig. 8.—Looking west at beginning of fill "1." Driven steel piles for grade separation structure at right center. Aggregate bins at extreme left. Truck haul road from cut "2" to extreme western end of fill "1" runs from lower left, winding around old Erie steam shovel and up on fill beyond piling

Fig. 9.—Left, Contractor D. Arrigoni. Right, Superintendent Anthony L. Arrigoni

Design and Control of Flexible Pavement Construction

By W. H. CAMPEN
and
J. R. SMITH
Omaha Testing Laboratories

DURING the past six years we have done considerable laboratory and field research work on the design and control of flexible pavement construction for streets, roads, and airport runways. Most of our work has been confined to pavements consisting of compacted soil sub-bases, compacted soil-sand-gravel bases, and hot mixed asphaltic wearing surfaces. In many instances the subgrades upon which we constructed our pavements were comparatively weak. As has been the case with other designers in the field of flexible pavements, we have felt from the very beginning that insufficient data were available on the stability and load carrying capacity of compacted soil mixtures to design this type pavement economically and adequately. By coordinating laboratory tests with actual field performance, we have developed a rational method of design. While this work is not complete, we feel that it is far enough along to warrant a preliminary discussion of the results obtained.

Stability Tests

The design of flexible pavements involves two major considerations, the first dealing with the stability and durability of the constructed soil and soil-aggregate layers, and the second with the load bearing and load distribution values of these layers. In brief the engineer wishes to be able to design economically pavements which will handle the desired loads under all weather conditions for a reasonable length of time.

We have come to the conclusion that the resistance of compacted soil mixtures to disintegration by natural forces can be measured by their behavior when submitted to such laboratory tests as drying, freezing, and capillarity. These tests are most significant when they are made on the soil mixtures as they are to be used in the pavement. And for this reason we conduct such tests on samples compacted in a standard Proctor mold to the density expected in the field.

The lineal shrinkage on drying is calculated by measuring the diameter of the sample before and after subjecting it to drying. The shrinkage or swell resulting from freezing at ten degrees below zero is likewise determined by measuring changes in the diameter of the sample before and after freezing. To prevent water loss during the freezing test the samples are completely coated with paraffin.

The capillary test is made by first casting the sample in the Proctor mold and then replacing the solid bottom of this mold with one perforated with small holes. The whole assembly is then placed in water with the perforated bottom down so that the bottom of the soil sample is submerged to a depth of ½ inch. This test is conducted in a saturated atmosphere. After remaining in this position for seven days any increase in weight or volume is noted. Volume increase is measured at the top of the sample.

These three tests have shown that available or easily prepared soil mixtures will show lineal shrinkages on drying as low as 0.5 per cent and still be plastic enough to be compactable. We have found that plastic soils can be compacted to show no absorption by capillarity. The freezing test deserves special attention because contrary to our anticipation compacted soils show both expansion and contraction during freezing depending on the thickness of the water film. When compacted to maximum density at optimum water content the soil samples contract on freezing and this contraction increases as the plasticity index of the soil increases. When the amount of water used for compaction is greater than optimum the contraction on freezing decreases with increase in water until a point is reached where expansion begins. By selecting the proper soil and water content the lineal shrinkage on freezing can be reduced to about 0.3 per cent on compacted soil mixtures.

Soil-aggregate mixtures show very little shrinkage (about 0.2 per cent) on drying and no absorption by capillarity when they are properly densified. Their action on freezing is noteworthy. If the plasticity in-

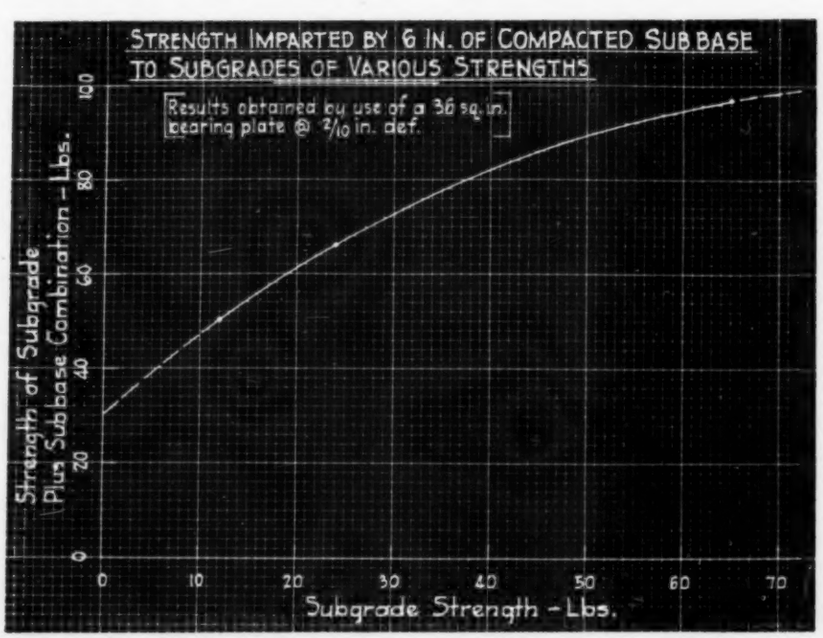


Fig. 1.—Strength imparted to various subgrades under certain conditions

dex of the soil binder used with the aggregate is below 10 the soil-aggregate sample expands during freezing and if the plasticity index is about 20 the volume change becomes nil. Soil-aggregate samples which expand on freezing return to their original volume on thawing. By selecting the proper kind and amount of soil binder the lineal change on freezing can be kept to within 0.2 per cent expansion or contraction.

In designing pavements and selecting borrow pits we strive to attain the following characteristics for the soil and soil-aggregate courses:

We believe that our stability tests are indicative of durability first because they are made on mixtures as they will be actually used in the field and secondly since the conditions of of the tests approximate the destructive forces encountered in the field.

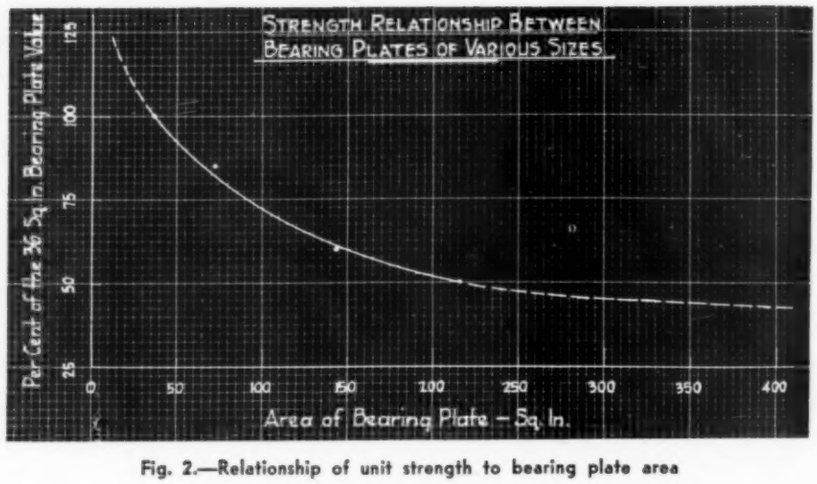


Fig. 2.—Relationship of unit strength to bearing plate area

	Subbase Course	Base Course
Shrinkage on drying (lineal)	Max. of 1 per cent	Max. of 0.2 per cent
Shrinkage on freezing (lineal)	Max. of ½ per cent	none
Swelling on freezing (lineal)	none	Max. of 0.2 per cent
Absorption by capillarity	none	none
Volume increase by capillarity	none	none

Strength Tests

After the designer has selected the most suitable soils and aggregates for subbase and base construction, he then needs data on the structural properties of the mixtures as well as on the natural subgrade upon which the pavement will be built. In order to design adequately and economically for the required load which must be supported, the following information must be obtained:

(1) The load bearing value of the subgrade at its weakest anticipated condition.
(2) The amount of strength imparted to the subgrade by adding upon it varying thicknesses of a compacted soil, hereafter referred to as the base course. course.
(3) The amount of strength imparted to the subbase course by placing upon it various thicknesses of a compacted soil-aggregate course hereafter referred to as the base course.
(4) A method by which the total load bearing support of the subgrade and combinations of it with subbase and base courses may be determined so as to represent the different load areas of various size tires.
(5) The amount of surface deformation which may be allowed safely to obtain maximum load bearing support without producing failure.

After reviewing and considering the prevailing methods as well as our own laboratory tests and field observations we have arrived at the conclusion that this problem must be solved by loading tests on samples large enough to represent actual field construction. We believe that we have devised such a method. Briefly, it consists of placing the soils in four foot square boxes and then testing them with bearing plates of varying sizes at what we consider a safe surface deformation.

Before using this method for designing purposes we conducted a series of experiments to obtain some general information about load bearing values. Three patches of typical soil were mixed with different amounts of water so as to produce a wide range of subgrade strengths. Each sample was compacted to a density equal to that obtained in a Proctor mold in a special steel box four feet by four feet by one foot deep. After compaction each soil was tested for load bearing values with four circular bearing blocks varying in size from one-quarter square foot to one and one-half square feet. All loads were observed when the bearing blocks had deformed the surface of the sample two-tenths of an inch and a few additional determinations were made at four-tenths of an inch deformation.

To determine the extent and the rate at which soil layers compacted at optimum moisture to maximum density improve a subgrade, boxes four feet by four feet by six inches deep were filled with other typical soils and superimposed on the subgrade. Each combination was tested as before. In the next step four-foot square boxes twelve inches deep were filled with the same typical soils and tested in combination with the subgrade as before.

The effect of superimposing six inches of base on two subbase combinations were next determined. One combination consisted of the weakest subgrade and six inches of subbase and in the other combination the strongest subgrade and six inches of subbase was used. The base consisted of a soil-sand-gravel mixture compacted to maximum density at optimum moisture content.

We found that these strength experiments indicated some definite trends which we tabulate below:

(1) The strength imparted to various subgrades when six inches of compacted soil subbase is placed over it is shown by the curve in figure 1. We found that when twelve inches of compacted soil subbase was used the strength imparted to the subgrade was double that imparted by six inches.
(2) We found that the strength increase produced by superimposing different base thicknesses on subbase-subgrade combinations was one and four tenths times that produced by the same thickness of subbase.
(3) We found that unit strength decreases as the area of the bearing plate increases but that this rate of decrease becomes small after the area of the bearing plates become greater than one and one-half square feet. This relationship of unit strength to bearing plate area is plotted in the curve in figure 2.

We are tabulating below two typical examples of strength increases imparted to subgrade by compacted subbase and base courses, the data

	Combination No. 1 lb./sq. in.	Combination No. 2 lb./sq. in.
Strength of subgrade alone	12	65
Subgrade and six inches subbase	50	97
Above with six inches base	104	143

being that for a quarter square foot bearing plate:

From the results obtained in these strength experiments we have derived a formula which we use to calculate subbase and base thicknesses required to produce the desired load bearing support for different subgrade strengths, and for varying wheel loads and tire pressures. Since during warm weather the bituminous wearing courses have little or no load distributive value, we do not consider them in our design except to design them sufficiently strong to prevent wheel penetration.

To illustrate what may be expected from compacted soil and soil aggregate courses we include the following examples of design calculated by using our curves and formula: (All subgrade strengths given are for a one-quarter square foot bearing plate.)

(1) With a 10 lb. per sq. in. subgrade and 6 in. of compacted base we find that in order to provide for adequate load bearing support for a truck with 75 lb. per sq. in. tire pressure and 10,000 lb. wheel load that the thickness of subbase course required is 11.8 inches.

(2) Same conditions as (1) above, except using only 3 in. compacted base we find that the subbase thickness required is 16 in.

(3) With a 25 lb. per sq. in. subgrade and 6 in. of compacted base we find that to support a 75 lb. per sq. in. tire pressure and 10,000 lb. load, we need a subbase thickness of 6.8 inches.

(4) With same conditions as (3) above only using 3 in. base we find that the subbase thickness required is 11 inches.

(5) With a 10 lb. per sq. in. subgrade, 30 lb. tire pressure, and 1200 lb. wheel load we find that with no subbase that a base thickness of 2.5 inches required.

(6) Same conditions as (5) above with no base that the thickness required for subbase course is 3.5 inches.

(7) With a 10 lb. per sq. in. subgrade, 75 lb. per sq. in. tire pressure, and 30,000 lb. wheel load we find that with a 6 in. compacted base course that we require a subbase thickness of 16.5 inches.

Fig. 3.—Testing in laboratory of 6 in. subbase superimposed on 12 in. subgrade using a 1½ sq. ft. bearing plate

(8) Same conditions as (7) above except a 25 lb. per sq. in. subgrade we find that the subbase required is 11 inches in thickness.

(9) Same conditions as (7) above except a 40 lb. per sq. in. subgrade we find that the subbase required is 8.1 inches in thickness.

(10) With a 20 lb. per sq. in. subgrade, 75 lb. per sq. in. tire pressure, and 50,000 lb. wheel load we find that with a 6 in. compacted base course that the required thickness for the subbase course is 12.1 inches.

Field Control

During construction we control the quality of the soils and soil-aggregate

Fig. 4.—Testing of subgrade in the field using hydraulic jack and 1½ sq. ft. bearing plate

mixtures by the plasticity index, the degree of compaction by the density, and the strength by the load bearing value test. The plasticity index and density tests are established tests and need no explanation. We determine the load bearing value by use of the set up shown in figure 4. This consists of circular bearing plates, a hydraulic jack with pressure gauge, and instrument to measure deformation, and a heavy piece of equipment to furnish loading weight for the jack.

From the subgrade to the base course each layer is tested before the next one is added. The testing of the subgrade is most important since it must have the desired load bearing value before construction is started over it. This desired load bearing value is obtained by either compacting the existing soils in the subgrade or if these soils are unsatisfactory by removing and replacing with satisfactory soil, followed by compaction.

Whenever possible the load bearing value tests are made with a one and a half square foot bearing plate and at 0.25 inch deformation. However, if this is not practical in the field, we use a smaller plate or a lesser deformation and convert to a standard plate and standard deformation by our strength relationship tables for various size bearing plates and various deformations.

In Conclusion

We wish to point out again that the results and conclusions presented herein are not decisive. Certain definite trends are indicated but it will require much more collaboration to establish positive conclusions. The methods of testing can be refined and a wide class of soils and soil-aggregate mixtures may be studied.

Overhaul Chart

(*Continued from page* 35)

87, a distance of 1,400 feet to Stations 389 — 87 and 417 — 87. The remainder of the roadway receiving material from the pit at Station 403 — 87 is divided into half-mile zones, numbered consecutively from nine to 15 as shown.

The accompanying chart was made for estimating purposes. The amount of material required in each zone was estimated, based on 25 cubic yards per station, or based on the cross sections. For payment purposes the amount of material placed in each overhaul zone is obtained from cross sectional embankment measurement with the addition of shrinkage. In some cases these amounts are determined from truck body measurements where it is impracticable to make the determinations from cross-sections. In the latter case the number of truck-measured cubic yards in each zone and the total number of truck-measured cubic yards from the pit is determined. A coefficient is obtained from this data, giving the equivalent pit-measured cubic yards for each truck-cubic-yard. Applying this coefficient to the truck-measured cubic yard in each zone, will give the amount of material in the zone based on pit measurement.

West Vi

By **WILLIAM C. BLIZZARD**
Assistant Secretary
West Virginia Publicity Commission

LIKE armies of ever-increasing insects, motor vehicles of all kinds are swarming from every compass point, converging upon the molasses pots of America—the defense production centers.

West Virginia is one of these "molasses pots." It is an industrial state. It produces more coal than any other state in the union (126,619,825 tons in 1940), and the collieries are clamoring for men, in a feverish attempt to supply enough fuel for the furnaces of the nation. Steel from Weirton, armor plate from South Charleston, and ammonia from Morgantown are pouring forth in a steadily growing stream.

As a result of the stepped-up industrial tempo of the last year, and anticipated possible military use, the state has inaugurated an extensive roads improvement campaign. Men must have roads to get to work, materials must be hauled, and the finished products must be shipped. Maximum efficiency requires that such roads be in first class condition. Modern warfare demands high speed and fast movement of troops, and speed requires smooth, safe highways.

Road building in West Virginia is no easy task, and the "mountain state" presents many engineering problems. The roads in the state are now costing $9,160,000 in construction and maintenance. Of that sum, $1,050,000 is being spent on roads that are directly contributory to the national defense program.

The visitor to the state at this time will be impressed with the magnitude of the road building project. Everywhere roads are being widened, resurfaced, or, in places, relocated completely. An example of this last-named construction is U. S. Route 60, which runs completely across the state, from east to west. This highway has been designated as part of the national strategic network, or SN, by the U. S. Army.

At one place, where a large armor plate plant, the U. S. Naval ordnance plant, and great chemical plants are located, SN Route 60 is being widened, for a distance of one mile, to a width of 60 feet—two thirty-foot lanes separated by a three-foot island. This project is a small part of a 68 mile defense zone extending from Hurricane to Gauley Bridge.

1.—The old road bed has been abandoned and U. S. 60 is here being completely re-routed near Anstead, West Virginia. This procedure is being repeated frequently in order to eliminate present curves and grade crossings.

2.—This picture shows a re-routing project on U. S. Route 19 near Flatwoods, West Virginia.

3.—Roads like this on U. S. Route 50 near Parkersburg, W. Va., are the object of the defense program. Near defense zones highways will be much wider—up to 68 feet.

4.—Curves like this one on U. S. Route 52 are being eliminated by re-routing as shown on U. S. Routes 19 and 60.

Virginia Builds Defense Roads

Within this space the largest road construction drive in the state is being carried on. Hills are being sliced through, bridges are being strengthened or rebuilt and curves are being straightened.

Other roads, particularly those leading into and out of defense boom zones, such as Morgantown and Fairmont, are being rapidly but serviceably rebuilt. One new road is being built straight through the heart of Fairmont, a town with a population of 23,000. A federal authorization now includes funds for the construction of flight-strips parallel to the highways, which would permit the landing of military planes.

Projects already under construction for the national defense program include: widening project on U. S. Route 60 near Huntington, where an additional 10 foot lane is being constructed; new construction near Ansted on U. S. Route 60, which will eliminate curves and several steep grades; reconstruction and widening U. S. Route 52 between Clark and Northfork and a new grade crossing elimination at Nolan on U. S. Route 52; a new bridge connecting U. S. Route 19 and a feeder highway near Jackson's Mill; widening and reconstruction of U. S. Route 21 through Ripley; construction of a bridge over Little Kanawha River at Elizabeth to replace the ferry now in use. (Across this bridge will go State Routes 14 and 53); relocation of State Route 26 near Tunnelton; a newly-constructed underpass on State Route 20 near Pine Grove in Wetzel County; a new bridge on the secondary road between Iaeger and Panther in McDowell County; construction of a new road through Fairmont to eliminate a bad traffic condition at the intersection of a streetcar line and a crossing road, in order to provide better access to defense plants in Fairmont; elimination of two dangerous railway crossings on U. S. Route 60 near Snow Hill, east of Charleston; reconstruction of four miles of U. S. Route 60 near Montgomery to eliminate a congested condition in that area; and widening projects on U. S. Route 119.

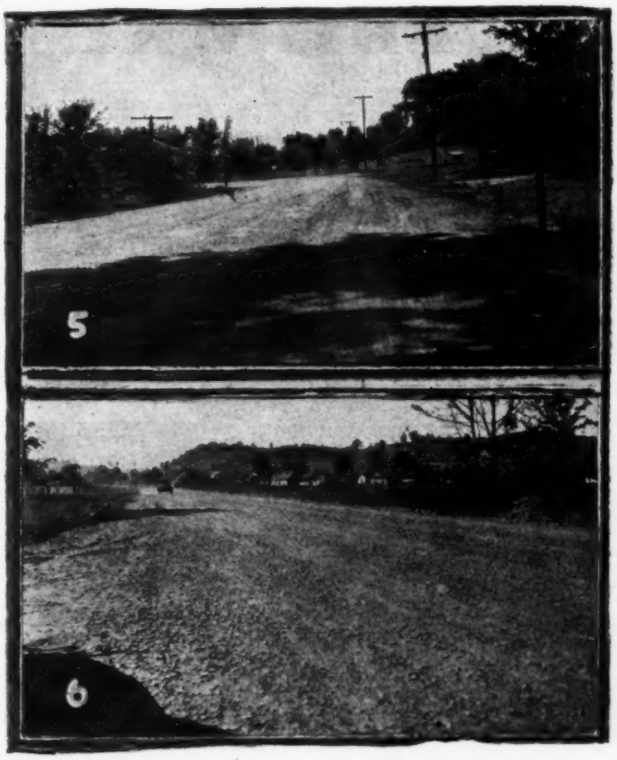
Realizing the handicaps which bad roads impose upon speed and efficiency, West Virginia has been gradually—and is just now rapidly—getting rid of them.

Freeways

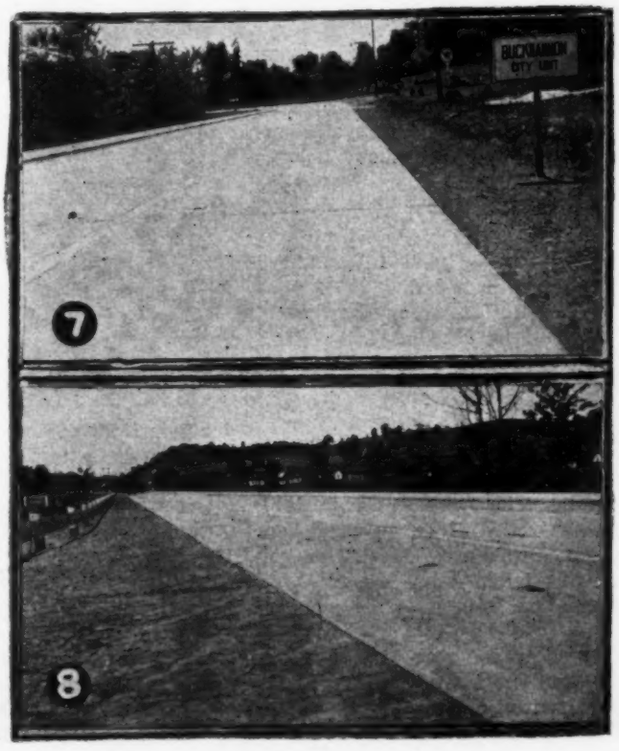
A development in some of the states is the statutory authorization of "freeways" which are highways designed for through traffic and to which abutting land owners have no right of access. Four States (Colorado, Maryland, Michigan and Ohio) enacted legislation for the establishment of freeways (limited access highways).

Colorado may designate any portion of a state highway, within 20 miles of a city of 15,000 or more population, as a freeway and control ingress and egress routes of the same.

Before



After



5.—Indicative of improvement of West Virginia Roads in the past few years. This was U. S. Route 119, near Buckhannon, West Virginia, before concrete paving was placed.

6.—Before the State launched into its defense highway program, U. S. Route 52, between Clarke and Northfork, was surfaced with gravel.

7.—U. S. Route 119, near Buckhannon, after paving.

8.—After the need of U. S. 52, view No. 6 was felt the state widened and paved the road. Shoulders were built wide enough to be used for parking if necessary.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

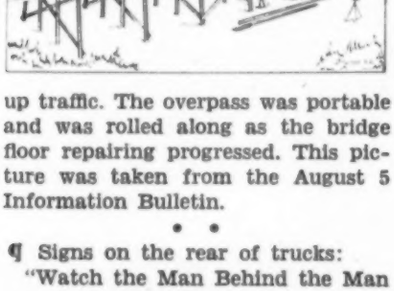
¶ Comes to my desk from L. H. Lingnor, this bit of wisdom, author unknown:

Think

If you think you are beaten, you are,
If you think you dare not, you don't;
If you'd like to win but think you can't,
It's almost certain you won't.
If you think you'll lose, you've lost,
For out in the world we find
Success begins with a fellow's will,
It is all in the state of mind.
If you think you're outclassed, you are;
You've got to think high to rise,
You've got to be sure of yourself before
You can ever win a prize.
Life's battles don't always go
To the stronger or faster man;
But soon or late the man who wins
Is the man who THINKS HE CAN.

• •

¶ Diagrammatic sketch by J. P. Harmon, senior office assistant of the Texas Highway Department, showing how the Neches River Bridge at Beaumont was repaired without holding

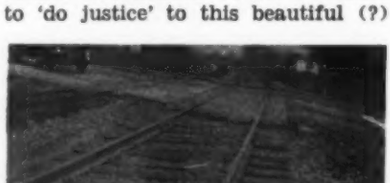


up traffic. The overpass was portable and was rolled along as the bridge floor repairing progressed. This picture was taken from the August 5 Information Bulletin.

• •

¶ Signs on the rear of trucks:
"Watch the Man Behind the Man In Front of You"
"Hit Me Gently, I'm Full of Pie"

¶ Speaking of railroad grade crossings, Bert Brumm of Cleveland sends this picture with the following comment: "It's difficult to get a camera to 'do justice' to this beautiful (?)



railroad crossing in Tallmadge, Ohio, over which Ohio Route 91 must pass. Suffice to say, you had better not negotiate this at more than 10 mph. or you'll wind up with a broken neck."

• •

¶ Herewith another remark from "John Q Public":

We like this idea of the Ohio State Highway Department of painting a yellow stripe inside the center stripe,

where sight distance is inadequate to permit safe passing. We learn from a state highway patrolman that tickets are issued for non-observance of this safety feature.

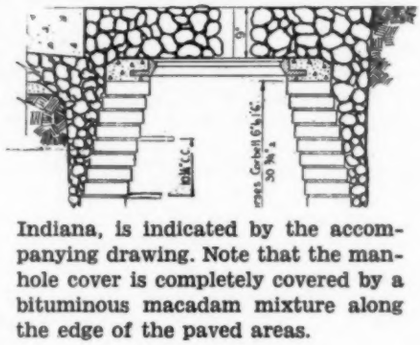
• •

¶ Safety note. Two thousand Americans die annually from taking the wrong medicine. Always examine the bottle carefully and then if you will put it back on the shelf without taking any, you'll probably feel just as well and be in no danger.

¶ A ladder, fastened on the side of a ship, has fourteen rungs, each spaced one foot apart. At low tide the water is exactly 1½ feet below the lowest rung of the ladder. The water at this particular point rises twelve feet at high tide. How many rungs of the ladder are submerged at high tide? (Answer bottom next page)

• •

¶ A design kink with regard to the surface drainage of the airport runways and other paved areas at Jefferson Proving Ground, Madison,



Indiana, is indicated by the accompanying drawing. Note that the manhole cover is completely covered by a bituminous macadam mixture along the edge of the paved areas.

• •

¶ During the nation-wide aluminum drive, the Shell Oil Company, St. Louis, Missouri, contributed a 10,000-lb. aluminum tank. This huge tank was the record contribution received in the St. Louis drive. It was

estimated that the tank contained enough metal for a pursuit plane. The LIMA crane owned by the Samuel Kraus Company, St. Louis, was used to unload the tank.

¶ Baxter L. Brown of St. Louis says the following remarks have been, in one sense of the word, his Bible for about 40 years:

Sand

I observed a locomotive in the railroad yards one day
It was waiting in the roundhouse where the locomotives stay;
It was panting for the journey, it was coaled and fully manned
And it had a box the fireman was filling full of sand.

It appears that locomotives cannot always get a grip
On their slender iron pavement, 'cause the wheels are apt to slip;
And when they reach a slippery spot their tactics they command,
And to get a grip upon the rail they sprinkle it with sand.

It's about this way with travel along life's slippery track
If your load is rather heavy and you're always sliding back,
So, if a common locomotive you completely understand,
You'll provide yourself in starting with a good supply of sand.

If your track is steep and hilly and you have a heavy grade
And if those who've gone before you have the rails quite slippery made
If you ever reach the summit of the upper tableland,
You'll find you have to do it with a liberal use of sand.

If you strike some frigid weather and discover to your cost
That you're liable to slip on a heavy coat of frost,
Then some prompt, decided action will be called into demand,
And you'll slip way to the bottom if you haven't any sand.

You can get to any station that is on life's schedule seen
If there's fire beneath the boiler of ambition's strong machine,
And you'll reach a place called Flushtown at a rate of speed that's grand,
If for all the slippery places you've a good supply of sand.

• •

¶ Smith: "My doctor advised me to go on a diet."

Green: "Did you do it?"

Smith: "After I got his bill, I had to."

• •

¶ Only the mint can make money without advertising.

¶ Did I get told off about my critical or complimentary remarks? Witnesseth:

STATE HIGHWAY DEPARTMENT
DOVER, DELAWARE

A. Puddle Jumper,
330 South Wells Street,
Chicago, Ill.

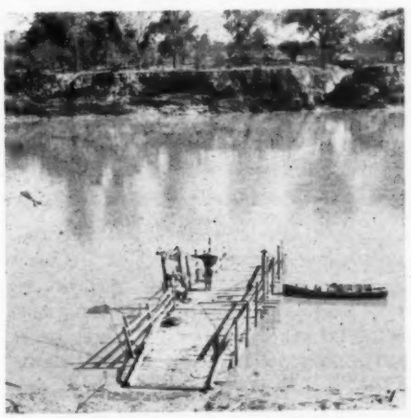
Dear Sir:

With reference to your item on Brandon, Miss., in the August 1941 issue, if you would stop complaining about those mid-western and southwestern roads and come to Delaware and ride on good roads, we could show you two towns with circular boundaries — Magnolia in Kent County with a one-quarter mile radius and Georgetown in Sussex County with a half mile radius. As far as I know there is no reason for the circular boundaries in either town except that the founding fathers liked them that way.

Very truly yours,
Richard A. Haber,
Jun. Eng.

• •

¶ Ferries are not all gone yet. This one across the Brazos River in Texas



at the end of Texas 249 is still doing business at the same old stand.

• •

¶ I took this picture of an F.W.D. truck towing a scarifier equipped blade grader in Montana to show lack of efficient management of a resurfacing operation. The big truck

is designed to carry its load instead of pulling one. The operation is preparatory to resurfacing by addition of new material and asphaltic cutback.

¶ Oldest known printed book bears the statement, "Printed May 11th, 868, by Wang Chieh, Province of Kansu."—*Whitcombings.*

• •

¶ A. P. J. must take it on the chin again. Last January (I believe it was) I criticized a railroad crossing in Texas. Mack Hodges, the state maintenance engineer took me to task for the remark because he could not locate the bump to which I referred. Last September I got cocky again, and by post card called his attention to the bump I meant. Was I wrong or was I wrong? It just goes to show—one cannot be too careful of what one says. The bump was a railroad crossing on U. S. 75 not U. S. 77. It is just outside of Dallas, to the south, and not 25 miles south. It is safe (according to Mack—but I still doubt it) at 60 m.p.h., the official speed limit. Of course, such slow speeds can make most any bump—not a bump. The night I hit that railroad crossing I thought I had "taken off"—in airways lingo. When I lit, quite a few feet beyond the crossing, it probably shook me so badly that I jumped two points in my number recollection. Anyway, Mack, my apologies for the error, not the speed.

• •

¶ I see that our dictionarish friend, Mr. Funk, who admits, on discovery of the fact which was concealed for some time, that he is a poet, has selected the "10 most beautiful words in the language."

What would you say they are?

He explains they are chosen because they are "beautiful in meaning and in the musical arrangement of their letters."

"Mother"?

Wrong . . . mother is not in the list. Apparently, the connotation of the word is all that is beautiful about it. What we have come to have it mean to us—not the word itself.

The "mother, home and haven," triangle is not in the list.

If you haven't seen the list, here it is:

Dawn	Mist
Hush	Luminous
Lullaby	Chimes
Murmuring	Golden
Tranquil	Melody

Do you use them?

That's the nice thing about them . . . they belong to the common vocabulary of most of us, though "Oh, yeah," and "blah-blah" and so forth have squeezed some of them out, perhaps.

• •

¶ Answer to Ladder Puzzle

None—the ship rises with the tide. Sorry.

Library—Laboratory Research

Knowledge of How to Secure and Use Reference Material is of Greatest Importance

By J. W. KUSHING

Research Engineer, Michigan State Highway Department

THE LIBRARY is one of the most important adjuncts to the tools of the laboratory research worker. It assists him in the planning of his work, as well as determining his course as the work progresses. It provides him with information unattainable elsewhere, and, at the same time furnishes a source of inspiration.

The progress of any branch of science depends how far the research workers within that field cooperate with one another in developing scientific knowledge and in applying that knowledge to the satisfaction of mankinds' common needs.

The unselfish nature of the research worker dictates that he relate his experiences and transcribe his conclusions. The methodical character of his technique requires that he have a plan. Therefore, it is natural and easy for the research worker to give a logical account of his work. The great number of scientific articles bear witness to this fact.

The rapid advance in applied science must be in part attributed to the methods whereby the printed word of many workers is made available to an individual research worker. Whatever may be the problem or the technique of research, the successful worker will make use of other conclusions, facts and arrangement of facts provided by other workers.

Two Classes of Research

Research may be classified into two broad phases, namely: scientific research and philosophical research. The province of the former is to ascertain what happens when certain things are done and the latter to determine values or what course of action should be followed under certain conditions.

Any laboratory research problem will necessarily incorporate the methods of one or both of these phases in its solution. The research worker in setting up his problem finds at once the necessity of obtaining information which will enable him to delimit his problem within the scope of his facilities and determine his method of approach.

Unless he has had considerable previous experience, his knowledge of the particular problem, must be supplemented by the experience of others in his field or allied fields. The fundamental laws and principles pertaining to his set-up must be understood. Newer concepts and ideas must be known to prevent him from wandering uselessly. Already proven facts must be his to direct his work into profitable courses.

This information can only be obtained from the written word of other investigators. The library is the only logical source for this information. Every research laboratory must possess access to an adequate library and every research worker must understand the use and importance of the library.

Must Know How to Use Library

Unless the research worker understands the use of this repository of knowledge, his efforts in the use of the library may be wasteful and fruitless. It has been surprising to the writer how many times it has been necessary to train college graduates in proper preparation of bibliographies and proper use of reference materials. To the interested reader, I should like to refer him to a bulletin entitled "Principles and Mechanics of Research" by John Edward Seyfried, University of New Mexico, Vol. 9, No. 1. This bulletin gives a short concise chapter on the use of the library as well as a chapter on Research References and Bibliographies.

Library Research of Great Value

The value of library research cannot be overestimated. F. V. Reagel in a paper before the American Association of State Highway Officials, 1939, entitled "Is There Duplication of Research," says: "Perhaps we should give separate classification to library research as a requisite to the efficient prosecution of any investigation." Failure to inquire into the results of other investigators before starting a research problem may lead to duplication and wasteful effort. Of this, Reagel says: "There is duplication of research and that may be desirable. There is also the inexcusable duplication of research brought about by the failure of the research worker to prepare for his research by familiarizing himself with work already completed by others interested in the same or allied problems."

Library research should be an important part of the research program of a research organization.

Wilhelm Ostwald, in "Fundamental Principles of Chemistry," states: "Two tasks are set for the worker in any science. One of these is to enrich the chosen field by discovery of new facts and the statement of new experiences. The other . . . is to arrange the facts already known in the best order and to bring out the relations between them as closely as possible. Whenever progress in the first of these tasks has been rapid, the second becomes the more necessary for it offers the only possible way of attaining mastery . . . and of bringing the science as a whole into a convenient and serviceable form."

A Great Service Can Be Rendered

Many research organizations limited in funds and personnel could render a great service, if they would direct their efforts to the second task which Wilhelm Ostwald so ably states.

In the highway field, considerable individual research has been done upon such problems as bituminous stabilization, load transfer in concrete pavement, proper thickness of flexible pavements and many others. To date, no effective summarization of this information has been brought together. Perhaps there are research workers considering these problems in this manner and soon we will have these compendiums so necessary to standardized practice. Nevertheless, these problems serve as an example of the work that can be done in library research.

Report Writing

A discussion of the library and laboratory research would not be complete without a few remarks concerning reports and articles prepared by research workers. It is unfortunate that so few workers have had the opportunity of proper training in report writing.

Too often the author of written material requires the reader to laboriously decipher his work, when a little more effort on the part of the writer would have saved the reader valuable hours.

A research report is essentially an account of some matter specially investigated which will be used by someone to a particular end. The principal criterion of its success is its careful planning in order to meet all the conditions under which it is to serve.

A successful report must be coherent and easily read. It must produce within the reader satisfaction for having read it. And, above all it must demonstrate that the writer has presented competent information concerning his subject in all of its phases and details.

More time spent on planning a report, more time spent on correlating the data, with statements of definite conclusions, will aid the library research worker in his important task.

It should not be interpreted that the writer advocates the acceptance of the conclusions of every written article. Yet, every article has a purpose and some thought was necessary in its preparation. Even a casual review of it may serve to some good end, for those who read cautiously.

Conclusion

In conclusion, it might be well to admonish each research worker—to cooperate with his fellow worker in writing concerning his experiences and thoughts—to learn to write informatively by writing more often and to encourage others to do likewise by reading and constructively criticizing their work.

Real Cause of Wage Boosts

By HALBERT P. GILLETTE

Essential as personal liberty is to industrial progress, it is not the only essential. The basic cause of the rise in "real wages" during the last 150 years has been the progress of pure and applied science. By "real wages" is meant wages measured in goods. This rise has been so great since the War of the Revolution that average real wages now are about five times what they were in George Washington's day. Yet for the 500 years preceding that war "real wages" were practically unchanged in England. I arrived at this fact by studying Roger's monumental treatise on "The History of Agriculture and Prices in England from 1259 to 1793."

During the 100 years that followed 1790, "real wages" in England became fourfold what they had been in 1790. What was the cause? Was it labor unionism? No, for that had existed in the form of guilds and otherwise for centuries, and had been more powerful in the year 1300 than in 1800. The initial cause was invention that led to the use of machines operated by steam power. The first economic steam engine was patented by James Watt in 1782, and its cheap power soon began to be applied to locomotives, ships and factory machines of all kinds.

Inventions for the use of power at once began to be made. By whom? Not by labor union leaders, for they were the greatest opponents of such devices; but by men of originality and persistence in every walk of life, and nowhere as often as in America. Why in America? Because it was truly the "home of the free and the land of the brave." Here trade guilds did not exist and labor unions had almost no members. Yet here the greatest and most prolonged rise in "real wages" occurred that had ever been witnessed.

It has been customary to attribute this to our great natural resources, but note two fatal objections to that theory: (1) that "real wages" in England rose almost as fast as in America, and (2) that "real wages" did not rise in India and China, and scarcely in Russia, in all three of which there is an abundance of natural resources.

One must inevitably conclude that inventive brains and freedom to apply inventions were and still are at the bottom of all this marvelous increase in real wages. But without labor unions, how were workers able to secure nearly 90 per cent of what they aided in producing? Competition among employers for the services of workers was, and still is in normal times, the primary cause of the securing of about 90 per cent of products by the workers. It is often said that the United States census shows that factory workers and those who produce the raw materials get only about 75 per cent of their produce, but this is an incorrect inference. Taxes that are paid by factories go to pay public employees, school-teachers, policemen, soldiers, sailors, all of whom are as truly workers as the men at the lathes. The cost of replacements of obsolete or worn-out machines is mainly a labor cost not shown in the census figures. The profits of the employer are really wages, if we determine those profits after deducting, say, 6 per cent interest on the invested capital. This return to capital rarely exceeds 10 per cent of the annual market value of a factory's produce.

In his best year Ford sold about a billion dollars' worth of cars, and the net income of his company was about 1/10th of that, out of which had to come taxes. Incidentally, had the present outrageous surtaxes existed, Ford would never have been able to build up his enormous business by which so many thousands of employees benefited. It is a very foolish policy, I believe, to take away from the most successful businessmen so large a part of what they earn. They stand second only to the scientists and inventors as the cause of the enormous rise in "real wages" during the last century and a half. Often, as in the case of Ford and Edison, the inventor and the businessman have been the same individual.

Labor unionism, at one time under one name and again under another, is one of the most ancient institutions. In India it is thousands of years old. They call it caste. You are born into one caste or another over there. Labor unionism there is in fact not only sanctioned by custom but sanctified by religion. Yet what has it profited any Hindu? Lacking one basic essential of progress, namely freedom to utilize the products of human ingenuity, those benighted serfs of unionism are among the worst paid men on earth. Most of them are still living as the English lived in the middle ages, before inventions had lifted the "Man of the Hoe" from the ground to a seat on a self-propelled plow. Markham, with a poet's license to be an economic ignoramous, wrote of that man as one whom employers had doomed to poverty and ignorance. The truth is that a man's poverty and ignorance are usually of his own making or that of his forebears.

From the Los Angeles Times of Nov. 10, 1941

The Physical Chemistry of Soil Mechanics

By RICHARD J. SHAW

Phoenix, Arizona

IN the study of soil mechanics much has been written from the engineers or experimental standpoint, in which the ideas of shear, sliding friction, and angles of distribution of load are developed with experimental data to support the ideas. In this paper no data will be given and no experiments described but a different concept of the problem will be proposed.

Results of Loading

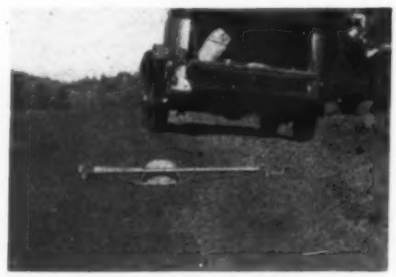
When a load or weighted object is placed on another substance any one of three things can happen; first, the loaded object is displaced more or less; second, it will be elastically compressed or, third, it will be elastically compressed followed by displacement. In the first case it is a liquid and does not concern us. In the second case it is a solid and in the third it is a plastic, but in all three work has been done. Work is the transference of energy by a process involving the motion of the point of application of the force. In the second case the work is returned to the loading object less, of course, the entropy of the system. In the third case most of the work is lost in deforming the material, unless the load is kept less than the yield value of the material, in which case it acts as an elastic substance.

In the formation of soil by the disintegration of rock, the newly created surfaces instantly adsorb the medium they are in[1], water or air. The particle may later exchange this layer for one for which it has more affinity, with a resultant lowering of the energy of the system. Usually this film is water, often oxygen[2], and possibly a double layer with oxygen next to the mineral, and the water adsorbed to this film. These films while under high pressure in one direction are comparatively fluid in the other two dimensions parallel to the surface of the mineral[3].

Shearing Conditions

If plastic flow is to take place in a saturated consolidated soil the shearing movements must occur in these adsorbed films. Since there must be a minimum pressure before flow will tinues as the load is transferred from start, it may be presumed that this is the small force required to move the adsorbed molecules from one point of adsorption to another point. Possibly the fact that energy is required at all is an indication that the surface of the isobar of the zeta potential is not a plane but is rather a pebbled surface[4].

The thickness of the film between the approachments of the particles, assuming the availability of the film material is unlimited and time for equilibrium is allowed, will depend on six factors; first, the attraction between the mineral and the film; second, the repulsion of the particles (because they carry like charges); third, the external pressure on the



Typical Subgrade Failure

This shows what happens when part of the work done on a road, by the loads passing over it, is consumed in forcing the soil to flow from under the most loaded wheel tracks towards the sides, and raising the shoulder material. This work of deformation is irretrievably lost

system (this may be negative); fourth, the surface tension of the film; fifth, the possibility of escape for the adsorbed substance; and sixth, the nature of the contact (point to plane, concavo-convex, etc.) These films have five actions; first, they keep the mineral particles separated; second, they more or less hold the solids in position; third, they lubricate the particles should an outside force cause rotation; fourth, they flow to relieve pressure; fifth, they entrap air which may act as a spring in compressing and expanding.

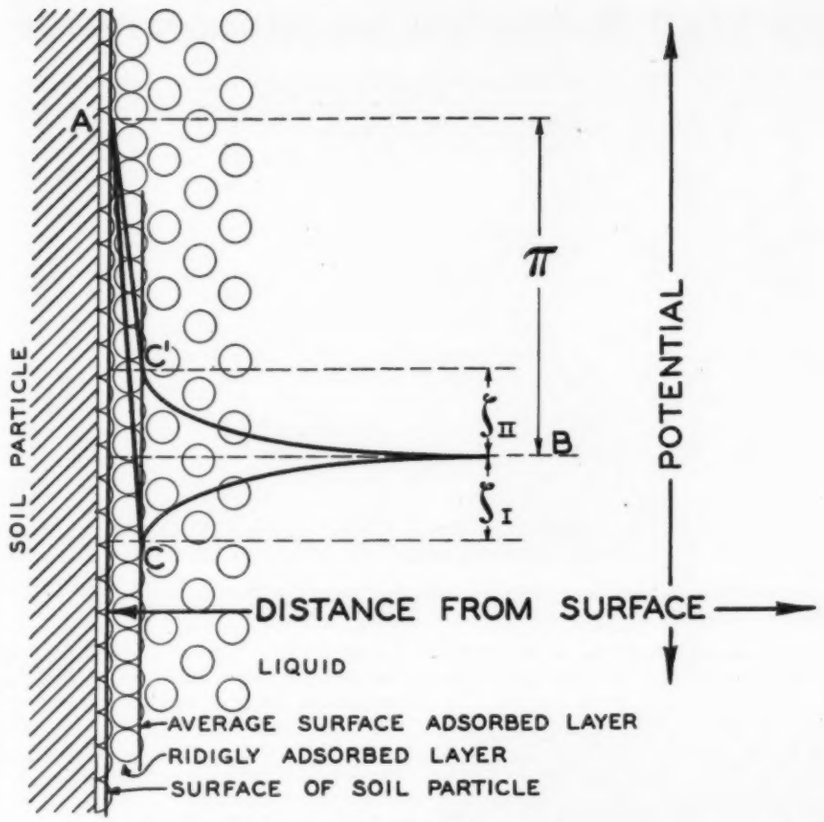
Load Transfer

When a load is applied to a soil it will compress the particles directly under it and tend to pull apart those under the edge. This action con- one layer to the next with the boundary stress becoming less distinct. The layers are not like piled cannon balls but are purely arbitrary and imaginary. A load P_1 on an area a on one side of a layer will be transmitted through the layer and on to the next as a pressure P_2. The unit shearing force will then be $\frac{P_1 - P_2}{c\ t}$; c is circumference and t is the thickness of the loaded segment. Except for the special case of particles exactly under the boundary it would seem impossible that any rotation can take place as the differential load is too small. If P_1 bearing on area a_1 is supported by P_2 bearing on area a_2 there will be a bending moment inducing a stress S_r, the formula for which is too complicated for solution at this time. This stress is opposed by the strength of the bond holding the adsorbed films to the particles and in this sense may be considered a negative pressure, acting at right angles to the load. In the last analysis this is opposed by the plastic properties of the soil, and when these are over stressed, by the inertia of the adjacent soil mass. However when this occurs, this mass is compressed with a resultant expansion of the stressed soil. This expansion offers an ideal opportunity for the entrance of water.

From this it may be seen that stability may be defined as the efficiency of a compression engine; and to insure a stable support for highway use we should have an engine of nearly 100 per cent efficiency.

Soil Failure Theory

The work may be consumed by adiabatic compression of the solids, liquids, or gases in the soil; in which case it is nearly all recoverable, while if the load is left in position until the compression becomes isothermal it is not recoverable and the soil has a tendency to fail. For example, an asphalt street may remain smooth under use while depressions appear along the curb where the cars stand. Work expended in forcing viscous flow, or in the extreme conditions sliding friction, is certainly lost; just as the work done by a river in flow-



Zeta Potential

(Drawn from Glasstone, "Physical Chemistry," page 1196; Van Nostrand)
A represents the potential of the soil particle, B the potential of the liquid phase and C the potential of the outer surface of the single layer of rigidly adsorbed liquid. C may be either less than B or more than B. π is the total difference in potential between the liquid and the soil particle (or other solid) and ζ is the difference in potential between the outer surface of the fixed layer and the interior of the liquid. The motion of a layer of the true liquid over the fixed layer will set up a back e. m. f. since a field of one intensity is being moved through a field of different intensity. The amount of the e. m. f. depends on the zeta potential and has the effect of a brake on the flow

ing is lost or the work of braking a car is lost. Sliding friction occurs when the stress causing plastic flow becomes too great and ruptures the material. In soils this rupture is a failure in tension as there must be an expansion of the soil at the surface of the break[5]. This surface can never be considered a plane as it passes around rather than through the soil particles.

When a load compresses the surface of a soil it stretches the surface layer, with the point of maximum stress probably under the center of the load, but because the loading device is reinforcing the soil, rupture will occur at the edge of the load; and for this reason it is commonly thought of as a shearing break. An example of this, before breaking, is the old trick of floating a needle on water. In the interior of the soil this same condition applies with the next layer above acting as the loading device. As has been pointed out there is an increase in area from layer to layer. If a soil with a low yield value is covered with one of high yield value, which is intended to act as a base the under side of the base will be especially subject to tensile strain[6], and as high yield values are associated with soils having a low adhesion factor failure at this point is the rule in such construction.

There is one more way in which work may be absorbed by a soil, that is defloculation. When a soil is partially dried some of the adsorbed films become so thin they cement the soil grains together with such force that water can not re-enter the interstices. Vibration or alternate compression and expansion opens these pores and may entirely change the character of the soil from that shown by the usual tests. These tests are run on the air dry sample and with a minimum of manipulation. It is well known that vibration of saturated soils increases the percentage of fixed water in a soil. This makes the soil more plastic and makes it cement harder when dry; Mexican laborers always pat the surface when molding adobe bricks; farmers are cautioned not to use tractors on water soaked fields. Some of the energy of loading soils may be thought of as going to increase the surface of the particles and is not recoverable.

REFERENCES

[1] Bancroft "Colloid Chemistry."

[2] Shaw, "Adhesion of Asphalts to Minerals," Arizona Streets and Roads Conference 1940; Abstract Highway Research Abstracts, January 1941.

[3] Glasstone, Text Book of Physical Chemistry. Page 1194

[4] Ibid. Page 1190.

[5] Richart, Brandtzaeg and Brown, A Study of the Failure of Concrete under Combined Compressive Stresses, Univ. Ill. Eng. Exp. Sta. Bull. 185, 1928.

[6] Hubbard and Field, "Thickness of Asphalt Pavement." Proceeding of 20th Annual Meeting Highway Research Board, 1940. Page 273.

$220,000,000 of New Federal Funds Now Available for Defense Highways

President Roosevelt on Nov. 21 signed S. 1840, the rewritten Defense Highway Act of 1941. The act provides authorization for:

$150,000,000 in Federal funds for access roads to military and naval reservations and defense plants;

$25,000,000 for improvement to the strategic network to be matched 25% by the states.

$25,000,000 in Federal funds for improvement to the strategic network, to be spent under FWA;

$10,000,000 for airplane landing and take-off strips along highways;

$10,000,000 for surveys and planning.

The act also provides that the Federal Government's share of costs of Federal aid highway projects during the emergency shall be increased from 50% to 75%, with the states furnishing 25% of the money. This includes funds already authorized but not spent, estimated at approximately $267,000,000.

The Commissioner of Public Roads is authorized to cooperate with the states in the location, development and construction of off-street parking facilities to expedite the flow of traffic on the strategic network.

Cost of acquisition of right-of-way for improvement to the strategic network and grade crossing elimination "to the extent determined by the Federal Works Administrator" may be included as part of the cost of such project. Where states are unable to obtain possession of required rights-of-way, the Federal Works Administrator is authorized to acquire such right-of-way by purchase, donation, condemnation or otherwise and to convey title to these rights-of-way to the states.

Section 10 authorizes the Commissioner of Public Doads to reimburse states for necessary rehabilitation or repair of roads and highways substantially damaged by the Army or Navy, or both.

Metal Crib Retaining Wall Holds Fill on Mountainside

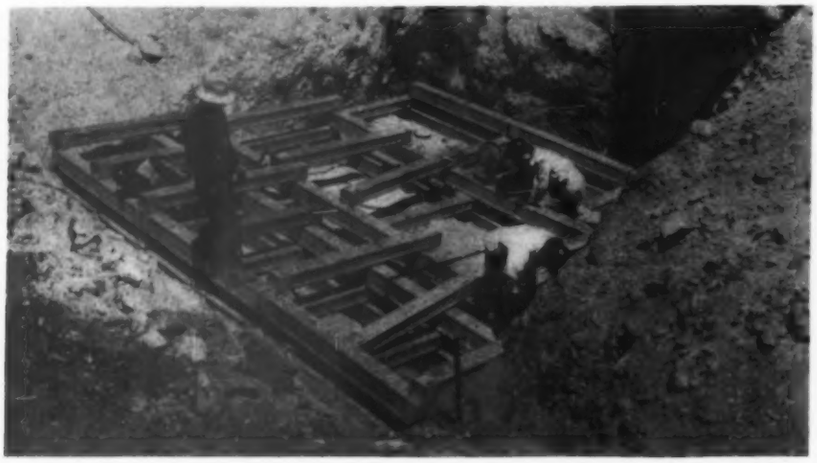
EARLY in March, 1938, Southern California experienced its most disastrous flood since 1864. All of the minor roads and major highways leading into San Bernardino were wiped out entirely or greatly damaged, so that for several days the city was like an island completely shut off from the rest of the state. In fact, the havoc was so general that even now, three years later, some of these roads are not yet open to traffic.

One of the most serious of the casualties was the great damage to the main transcontinental highway leading into the city through Cajon Pass, commonly known as the Blue Cut. This section of state highway is particularly interesting geologically, since it passes directly over the San Andreas fault, and earthquake rift that is responsible for many of California's major earth tremors. The rock, known as pelona schist, which lies along the top of the rift, has been ground into fine, almost powdery form by the constant shifting back and forth of the earth strata. Since this material is so fine, it has proved to be a real landslide hazard, and very difficult to keep within bounds.

The old highway leading through the Blue Cut Gorge had been built with embankments partially protected by rubble walls. However, the flood of 1938 was so much higher than any other measured in the history of this district, that the water rose far over the tops of the walls, and carried out the embankments, with the result that parts of this section of highway were completely obliterated.

The distance through the gorge is approximately one-half mile. It was possible to set the road back into solid rock for this entire distance, except for some 200 feet, where the rock fell away from the line. A retaining wall on which to rest this 200-foot section of the highway was erected.

As the construction of the cribbing advances, the back fill is kept constantly moistened, so that it will be firm and compact



After all the loose soil has been cleared away, the workmen begin the foundation of the crib retaining wall. The cribbing thus starts at a solid rock base, a factor which insures rigidity and permanence

Construction

The metal crib retaining wall consists of a series of rectangular cells made up of box-type metal headers and stretchers secured by bolts, nuts, and lugs. The crib members are of 16-gauge metal, reinforced with metal inserts at the ends and also at locations where heavy loads are imposed at points of contact between headers and stretchers. The members were galvanized with a coating of prime spelter.

In the construction, the foundation was first excavated to bed-rock, and the cribbing was accurately placed to the established lines and grades.

Because of the lack of back fill material at the site of the metal cribbing installation, loose soil was transferred from the nearby creek-bed

The above picture shows the completed metal cribbing job as viewed from the creek-bed. The highway may be seen behind the white guard-rail, with the creek-bed in the foreground

The headers and stretchers, upon assembly, were interlocked by means of a flexible lug and bolt connection. Inserts and spacers were placed at required locations. The exposed ends of headers were protected by metal caps.

Cells formed by the cribbing, and the space between the cribbing and the hillside were backfilled with a selected material free from large rock. Backfilling progressed simultaneously with the erection of the vertical courses of the cribbing, and was placed in uniform layers not more than one foot thick, and thoroughly tamped into place.

The cribbing wall was constructed to a 1:6 batter, with the cross section width increasing as the height of the wall increased. The number of the individual members follows:

60 each 6 in. by 6 in. by 4 ft. metal headers
638 each 6 in. by 6 in. by 6 ft. metal headers
10 each 6 in. by 6 in. by 8 ft. metal headers
10 each 6 in. by 6 in. by 6 ft. metal stepback headers
10 each 6 in. by 6 in. by 8 ft. metal stepback headers
7 each metal header spacers
7 each metal header inserts
418 each metal header caps
1055 each 6 in. by 8 in. by 6 ft. metal stretchers
272 each metal stretcher inserts
2 each gap joints

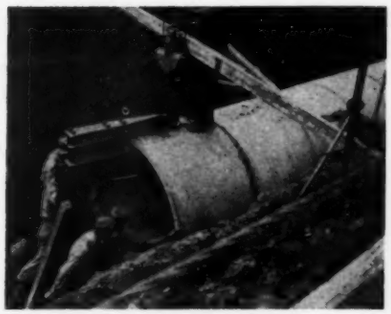
Cribbing members and parts were made by the American Rolling Mills and obtained from the California Corrugated Culvert Company.

Mr. Hall of the W. E. Hall Construction Company, Alhambra, California, which was the low bidder on the job, chose to bid only on metal cribbing, although he had the alternate choice of bidding on concrete also. Metal cribbing had been previously used on other highway jobs in this district and had proved very durable and fully able to withstand the perennial spring floods which characterize this mountainous locality.

Ohio Highway Defense Job Eliminates Ditch Hazard

Replacing a narrow and ditch-flanked section of U. S. Route 25 in Wood County, Ohio, with a safe, four-lane highway, meeting both military needs and those of the civilian population is a defense project just completed by the Works Projects Administration and the State Highway Department in Wood County, Ohio. It stretches for six miles along the strategically important U. S. Route 25, between the communities of Perrysburg and Bowling Green and is known locally as the Dixie Ditch. Since it is a federal route, it is one of the primary north-south highways

Condition of roadside ditch prior to enclosing in a large reinforced concrete pipe sewer



Crane spotting joint directly under a grade board

in the western part of Ohio and carries an average of 5,000 vehicles per 24 hour day. The fact that 18 per cent of these vehicles are trucks is indicative of its importance as a commercial hauling route. It is estimated that motorists account for more than 17,000,000 miles of travel on the highway between Bowling Green and Perrysburg.

The WPA installed pipe and upon

Backfitting the neatly laid pipe line. To point midway on pipe, backfilling was done by hand

completion of installation and backfilling the State Highway Department increased the width of the present 22-foot road by another 22-foot lane. Cost of eliminating the ditch is estimated at $856,562.00.

The highway department fur-

Completed job. Hazardous ditch eliminated and surface graded preparatory to placing second 22 ft. surfaced section

nished the location and plant and let the job of manufacturing the pipe on the site to contractors. WPA labor and some supervision was used to operate the plant which was let out to Launder and Son, Inc., Toledo, Ohio, for slightly more than $131,000. Approximately five miles of 54, 60, and 66-inch pipe were made.

New Amendments to Preference Rating Order P-22 Priority

Assistance Extended to Contractors

A NUMBER of amendments to Preference Rating Order P-22, covering repair, maintenance and operating supplies, as announced by the Priorities Division, OPM, was released by the American Road Builders' Association.

Amendment "'A" embodies three changes, designed to assist important industries heretofore not specifically covered by the order.

The first of these changes brings natural gas, and hydrocarbons associated with petroleum, under the terms of the order, and extends its assistance to the transportation as well as the production of these items. This means that pipelines, railroads, and truck fleets engaged in moving the products of the petroleum industry, may now apply the A-10 rating to the acquisition of necessary repair and maintenance parts and operating supplies. Petroleum production was covered in the original order.

Another change brings within the terms of the order privately-owned irrigation systems, toll bridges and toll canals. Previously, units within these categories were assisted only if they belonged to governmental units.

A third paragraph extends the assistance of the order to those using tools or equipment to repair or maintain the property of other producers. Priority assistance is thus extended to independent contractors and others, such as machine and repair shops, blacksmiths, and similar repair and maintenance operators.

Amendment "B" defines operating supplies as before, but rewords the definition to state that such supplies shall not include "any material which the producer acquires solely to distribute, store, or transport."

Amendment "C" makes two important changes. It deletes the provision of the previous order which refused assistance in replacement of equipment by improved equipment, and prohibited replacements "unless such existing installation is beyond repair." It has been found impossible, and in many cases undesirable, to require replacement with equipment exactly like the old. The procedure frequently held the producer to the use of antiquated equipment, and sometimes made it impossible for him to obtain any replacement equipment at all.

Amendment "D" changes the method by which exemption of various industries from the restrictions on deliveries, withdrawals and inventories, may be granted.

The order excepts public utilities from the terms of P-22, if they are covered by Preference Rating Order P-46, as amended from time to time.

Mines not receving the assistance of the mine repair order may benefit from the terms of Preference Rating Order P-22.

The order as now amended makes provision for highway contractors to use the A-10 rating on orders for repair parts and replacement for their plants and equipment either for maintenance or construction work. It is not necessary that the equipment be employed on a job at the specific time the rating is used. In other words any highway contractor who regularly does highway work is entitled to use the A-10 rating in accordance with the provisions of the order.

TITLE 32—NATIONAL DEFENSE
CHAPTER IX
OFFICE OF PRODUCTION MANAGEMENT
Subchapter B—Priorities Division
Part 958
REPAIRS, MAINTENANCE, AND SUPPLIES
AMENDMENT No. 1
TO PREFERENCE RATING ORDER No. P-22 AMENDED

(a) Section 958.1 (Preference Rating Order No. P-22 Amended paragraph (b)(1) is hereby amended to read as follows:

"(b)(1) 'Producer means:

(i) any governmental unit;

(ii) any individual, partnership, association, corporation, or other form of enterprise engaged in one or more of the following activities or acting in one or more of the following capacities to the extent that it is so engaged or so acts:

(a) manufacturing, processing, or fabricating;

(b) warehousing — maintaining warehouses for storage or distribution of any material;

(c) wholesaling — acting as a distributor of products sold to manufacturers, wholesalers, retailers or other persons not consumers;

(d) charitable institutions — any charitable or eleemosynary institution which is recognized as such for purposes of the Internal Revenue Laws of the United States;

(e) carriers — urban, suburban, and interurban common or contract carriers of passengers or freight by electric railway, electric coach, motor truck, or bus, including terminals of any of the foregoing; railroads, including terminals; shipping — commercial carriers of freight and passengers by ocean, lake, river, or canal, including terminals;

(f) educational institutions (including vocational training);

(g) printers and publishers;

(h) radio — commercial broadcasting and communication;

(i) telephone and telegraph communication, including wire services;

(j) hospitals, clinics, and sanatoriums;

(k) Petroleum and Natural Gas — discovery, development, and depletion of pools of petroleum and associated hydrocarbons, and transportation of petroleum, associated hydrocarbons and derivatives thereof;

(l) irrigation systems, whether publicly or privately owned;

toll bridges and toll canals.

(iii) Any person using tools or equipment to repair or maintain the property of any Producer as defined in (b)(1)(i) and (ii)."

(b) Section 958.1 (Preference Rating Order No. P-22 Amended paragraph (b)(5)) is hereby amended to read as follows:

"(b)(5) Subject to subparagraph (6), 'Operating Supplies' means any Material which is essential to the operation of the Producer's business and which is consumed in the course of such business, including without limitation, fuel, lubricants, catalysts, and small perishable tools: *Provided*, it shall not include any Material which is physically incorporated, in whole or in part, into any product of the Producer, or any Material which the Producer acquires solely to distribute, store or transport."

(c) Section 958.1 (Preference Rating Order No. P-22 Amended paragraph (b)(6)) is hereby amended to read as follows:

"(b)(6) The terms 'Maintenance,' 'Repair 'and 'Operating Supplies' *do not* include Material:

(i) for the improvement of a Producer's property or equipment through the replacement of Material in the existing installation, unless such equipment is beyond repair;

(ii) for additions to, or expansion of, such property or equipment;

(iii) which is of a type not heretofore carried on the Producer's books under 'Maintenance,' 'Repairs,' 'Operating Supplies,' or the equivalent."

(d) Section 958.1 (Preference Rating Order No. P-22 Amended paragraph (g) is hereby amended to read as follows:

"(g) *Restrictions on Deliveries, Withdrawals, and Inventory.*

(1) Except as provided in paragraph (g) (4) and (5), no Producer shall, during any Calendar Quarterly Period, accept deliveries (whether or not rated pursuant to this Order) of any items of Material to be used as Operating Supplies or for maintenance or Repair the aggregate dollar volume of which shall exceed twenty-five percent (25%) of the aggregate dollar volume of the withdrawals of items of Material of the same class as carried on the Producer's books from stores or inventory during the calendar year 1940.

(2) Except as provided in paragraph (g) (4) and (5), no Producer shall, any time, accept deliveries (whether or not rated pursuant to this Order) of any item of Material to be used as Operating Supplies or for Maintenance or Repair until the Producer's inventory and stores of items of Material of the same class, as carried on the Producer's books, have been reduced to a practical working minimum. Such practical minimum shall in no case exceed the aggregate dollar volume of items of Material of the same class, as carried on the Producer's books, in inventory and stores of December 31, 1940, or, at the Producer's option, at the close of the Producer's fiscal year ending during the calendar year 1940.

(3) Except as provided in paragraph (g) (4) and (5), no Producer shall, during any Calendar Quarterly Period, make withdrawals from stores or inventory of any items of Material to be used as Operating Supplies or for Maintenance or Repair the aggregate dollar volume of which shall exceed the aggregate dollar volume of the withdrawals of such items of Material of the same class, as carried on the Producer's books, during the corresponding quarter of 1940, or, at the Producer's option, twenty-five percent (25%) of the aggregate dollar volume of the withdrawals of such items of Material of the same class as carried on the Producer's books during the calendar year 1940.

(4) From time to time the Director of Priorities may determine that certain Producers or classes of Producers are exempt, in whole or in part, from the restrictions contained in paragraphs (g) (1), (2), and (3).

(5) Restrictions contained in paragraphs (g) (1), (2), and (3) shall not apply to any Producer during any Calendar Quarterly Period in which the total volume of his purchases or withdrawals of Material for Maintenance, Repairs, and Operating Supplies does not exceed two thousand five hundred dollars ($2,500)."

(e) Section 958.1 (Preference Rating Order No. P-22 Amended paragraph (i)) is hereby amended to real as follows:

"(i) *Utilities and Mines Excepted.* This Order is not applicable to any Utility defined as a Producer in Preference Rating Order No. P-46 (section 978.1) as amended from time to time, nor to any Mine Operator as defined in Preference Rating Order No. P-56 (section 982.1). The Director of Priorities may from time to time specifically except further classes of Producers from this Order by specific direction."

(f) *Effective Date.* This amendment shall take effect immediately.

(P. D. Reg. 1, Aug. 27, 1941, 6 F. R. 4489; OPM Reg. 3 Amended, Sept. 2, 1941, 6 F. R. 4865; E. O. 8629, Jan. 7, 1941, 6 F. R. 4483; sec. 2 (a), Public No. 671, 76th Cong., 3d sess., as amended by Public No. 89, 77th Cong., 1st sess.; sec. 9, Public No. 783, 76th Cong., 3d sess.)

Issued this 10th day of November, 1941.

Donald M. Nelson,
Director of Priorities.

New Interpretation Outlaws Equipment Purchases Under Preference Rating Order P-22 Amended

A recent ruling of the Maintenance and Repair Section of the OPM holds that the A-10 rating granted under Preference Rating Order P-22 Amended does not apply to 'replacements made of capitalized equipment, nor of equipment which is subject to amortization or depreciation in the producers normal accounting practice even if such equipment is not carried as capital."

A copy of the OPM memorandum setting forth this interpretation is quoted in abstract below, verbatim. Your attention is specifically called to paragraphs 4, 8 and 10.

OFFICE MEMORANDUM
November 27, 1941

TO: The Priorities Field Service
Attention District Manager

FROM: William J Hays

SUBJECT: Interpretations under Preference Order P-22 AMENDED and Amendment No. 1

4. CONTRACTORS

Amendment No. 1 to Preference Rating Order P-22 AMENDED states

in paragraph (b) (iii) the following:

"Any person using 'tools or equipment' to rtpair or maintain the property of any producer as defined in (b) (1) (i) and (ii)".

Mr. Low has ruled that all independent contractors are now within the scope of the Order; all building contractors as "Fabricators"; excavating contractors, machine and welding shops, and well drillers as "Processors." This includes all contractors and machine shops, whether or not their work is being performed for a producer.

8. REPLACEMENT ON CAPITALIZED EQUIPMENT

Replacements cannot be made of capitalized equipment; nor of equipment which is subject to amortizatio nor depreciation in the Producer's normal accounting practice even if such equipment is not carried as capital.

In other words, replacements can be made only of items that have been carried in a maintenance, repair or operating supply account; which do not become a part of the finished product; and, which are not subject to depreciation.

10. WELDING RODS AND CONTAINERS

(1) Welding rods are the operating supplies of a producer. They are, therefore, considered operating supplies for a repair shop and, as such, may be acquired under the provisions of Order P-22 AMENDED.

(2) Containers of any sort whether or not they are re-useable or returnable, to the producer are *not* considered operating supplies under this Order.

New Interpretations of Preference Rating Order P-22 Amended and Amendment No. 1

Jerome H. Low, Chief, Maintenance and Repairs Branch, Office of Production Management, in an office memorandum addressed to the Priorities Field Service, issued several new interpretations relative to the application of Preference Rating Order P-22. Paragraphs 1, 2, 3, 5 and 6 of this memorandum, which are applicable to the highway industry, are quoted below:

1.—WHEN A-10 PROVES INSUFFICIENT TO PROCURE MATERIAL.

When it is found that a higher Rating than A-10 is needed to procure needed material, a PD-1 application should be filed with the Priorities Division, Office of Production Management, Washington, D. C. A statement should be incorporated in the PD-1 application to the effect that the applicant was unable to obtain the material with the A-10 Rating granted under Preference Rating Order P-22 AMENDED and the reason why.

If this statement is not incorporated in the Form a supporting affidavit to that effect should be attached thereto.

2.—PRIORITY RATINGS FOR REPAIR PARTS FOR TRUCKS, BUSSES, TRAILERS.

Preference Rating Order P-22 AMENDED should not be used to secure repair parts for trucks, trailers, or busses which are covered under Preference Rating Orders P-54 and P-57.

No Priority Ratings should be requested by the manufacturers of these parts from the jobbers, nor should any Priority Ratings be requested by the jobber of the fleet owner or the individual.

Copies of any letters containing such request should be sent either to this Branch or to the Automotive Branch.

3.—PREVIOUSLY PLACED ORDERS.

When the Rating of A-10 is applied to a purchase order that was filed previously to the date on which P-22 AMENDED became effective, a duplicate purchase order properly signed and endorsed must be forwarded to the supplier. Attachments to the original order, such as stickers or certificates or even a letter, authorizing the use of the A-10 Rating are expressly prohibited.

5.—REBUILDING EQUIPMENT FOR SALE OR RENTAL.

Preference Rating Order P-22 AMENDED may *not* be used to purchase repair or maintenance material used in rebuilding machines or equipment for sale or rental, and the A-10 Rating may *not* be applied to orders covering such material. It is suggested that in this case a PD-1 application be filed with the Priorities Division, Office of Production Management for your specific needs.

6.—LEASED EQUIPMENT.

Equipment leased to a producer may be repaired by the producer under the provisions of Preference Rating Order P-22 AMENDED as long as it is in the possession of the producer. As soon as the lease is terminated and the equipment is returned to its original owner, it may not be repaired unless the original owner is a producer as defined in the Order.

Some Questions on A-10 Answered

On November 29 the American Road Builder's Association addressed several inquiries to the Maintenance and Repair Branch of the Office of Production Management regarding Preference Rating Order P-22 Amended and Amendment No. 1. The questions submitted were as follows:

1. Can the A-10 rating granted under Preference Rating Order P-22 Amended and Amendment 1 be applied to purchases of construction equipment where such purchases are replacements and do not constitute an expansion of equipment inventories?
2. Under what circumstances, if any, can the A-10 rating above referred to be applied to purchases of construction equipment?
3. In the event that delivery of repair parts cannot be obtained with an A-10 rating what procedure should be followed? (a) Under normal conditions? (b) In case of emergency?
4. Can a governmental agency apply the A-10 rating for repairs to construction equipment when the same is not owned by such egency but in their possession under a rental agreement?
5. Does Amendment No. 1 to Preference Rating Order P-22 Amended grant the use of the A-10 rating to highway contractors to the same extent as to the "Producers" as defined in said order?

Following is a letter received from the OPM categorically replying to the questions submitted. Believing this letter further clarifies some of the questions pertaining to the administration of the maintenance and repair order, it is quoted below verbatim.

"American Road Builders' Association
International Building
Washington, D. C.
Attention: Mr. Burton F. Miller
Executive Assistant

Gentlemen:

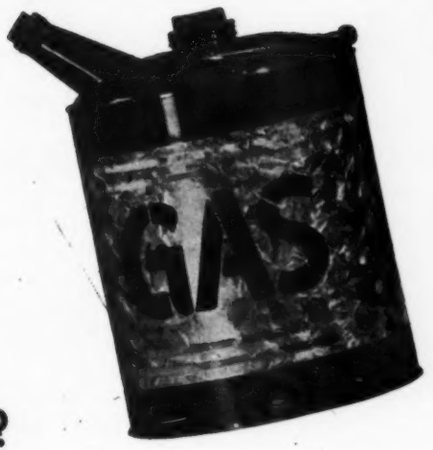
Your letter of November 29 addressed to the writer in reference to the application of an A-10 preference rating, received.

Question No. 1—An A-10 preference rating cannot be applied under Preference Rating Order P-22 AMENDED and Amendment No. 1 for the purchase of construction equipment except when such equipment has been carried on the books and charged to expense or operating supplies. Such equipment would, for example, be small tools and hand tools which normally are expendible and carried as operating supplies.

Question No. 2—There are no cir-

(Continued on page 76)

In these days . . .



would you buy a gasoline that would give you twice the mileage and power—?

Yes—and you would be glad to pay a premium price for it, too.

The same logic would apply to wire rope—and in that connection we offer—

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Reviews of Books and Booklets

Traffic Accidents and Congestion

This is a 400-page volume by Maxwell Halsey, Associate Director of Yale Bureau for Street Traffic Research. The subject is conveniently divided into 5 sections. Part One and Two is on Orientation, giving the problem; the importance of velocity; organization; and administration. Part Three covers the Driver; Human Abilities; Potential Conflicts; Reduction of Human Abilities; Human Nature; and Changed Conditions. Part Four, the basic principles and elements of design. Part Five discusses the Approach to the Problem and Putting the Program to Work.

The illustrations are numerous and well chosen, and assist in a real understanding of the physical and psychological questions involved. Jno. Wiley and Son, 440 Fourth Avenue, New York City. Price $4.00 in buckram binding.

The New Army of the United States

The transition of the small, skeletonized United States Army to a large, well organized and fully equipped fighting force of seasoned and trained soldiers is a project of vast magnitude and complexity.

Realizing the deep interest of the American public in their new Army and the difficulty of grasping the Army's development at any one moment, this book attempts to give a fairly complete report on the Army as of August 1, 1941—its organization and the missions, methods and equipment of its various components.

In this period of swift and continuing transition, important changes will have been made with the passage of weeks or months. The book is the work of the Bureau of Public Relations of the War Department. A copy may be obtained by sending thirty-five cents to the Government Printing Office, Washington, D. C., and asking for F. M. 100-5.

Traffic Engineering Handbook

This book is a collation in one volume of basic traffic engineering data designed to serve as a day-to-day guide to best practices in those portions of the traffic engineering field in which well-accepted principles have been established. It is a pioneer work in a field in which the literature consists mainly of pamphlets, reports, and articles in professional journals, each covering only a limited portion of the field, with only two or three book length treatments which fall in the category of general textbooks.

Fourteen nationally known traffic engineers participated in the writing of complete sections of this book, which is co-edited by Harold F. Hammond, director of the traffic division of the National Conservation Bureau, and Leslie J. Sorenson, city traffic engineer, Chicago, Illinois. The book is jointly published and will be distributed by the Institute of Traffic Engineers, professional traffic engineering fraternity, and the National Conservation Bureau, of 60 John Street, New York City. It will be priced at $3.25 the single copy. Quantity prices will be quoted on request.

The book is designed for use by state, county, municipal, and consulting engineers; officials and administrators, police departments, engineering schools, commercial transportation executives, and all others interested in improving the efficiency and safety of motor vehicle traffic flow.

Proceedings Thirteenth National Asphalt Conference

This report credits the Asphalt Institute and the Association of Asphalt Paving Technologists as holding the conference with the cooperation of the United States Public Roads Administration. The Highway Research Board of the National Research Council, and the Texas State Highway Department.

In 236 planographed pages, quite fully illustrated, the following subjects have been discussed:

Roads and National Defense, by Patrick J. Hurley, former Secretary of War; *Highway Development in Oklahoma,* by S. H. Singleton, Chairman, State Highway Commission; *Airports and National Defense,* by Maj. A. B. McMullen, Chief, Airport Section, CAA; *Adapting Our Highway System to National Defense,* by Thomas H. MacDonald, Commissioner, Public Roads Administration; *Highway Requirements for Military Transport,* by Capt. Wm. C. Baker, Jr., Corps of Engineers; *Reinforcing and Widening Existing Highways,* by D. C. Greer, Texas State Highway Engineer; *Supplementary Construction to Eliminate Bottlenecks,* by Bernard E. Gray, Chief Engineer, The Asphalt Institute; *Military Roads in Forward Areas,* by W. N. Carey, Col., Corps of Engrs., Res.; *Selection and Use of Available Materials,* by C. D. Snead, District Engineer, Public Roads Administration; *Personnel and Equipment for Military Highways,* by W. B. Greene, Vice-President, Barber-Greene Company; *Storage and Placement of Highway Materials,* by Col. Earl B. Lockridge, Chief Engineer, State Highway Commission of Indiana; *Highway Principles and Practices Applicable to Airports,* by Roy W. Crum, Director Highway Research Board; *Subgrade Preparation and Base Construction,* by E. A. Willis, Associate Highway Engineer, U. S. Public Roads Administration; *Choice of Surfacing Types for Airports,* H. H. Houk, Civil Aeronautics Administration; *The Washington National Airport,* Col. R. S. Thomas, Corps of Engineers, U. S. Army; *Cleveland Municipal Airport,* Major John Berry, Commissioner of Airports; *Missouri River—Outline and Analysis of Asphalt Revetments,* by Major Helmer Swenholt, Executive Assistant, Corps of Engineers, U. S. Army; *Interesting Developments in Asphalt Construction by the WPA,* by John P. Hallihan, Director, Municipal Engineering Section; *Factors Governing the Selection of Aggregates—Practice in Texas,* by E. B. Cape, (formerly) Materials and Tests Engineer, Texas Highway Department; *—Practice in North Carolina,* by T. V. Fahnestock, Bituminous Engineer, North Carolina State Highway Commission; *—Practice in Michigan,* by J. G. Schaub, Engineer of Construction and Operations, Michigan State Highway Department; *— Practice in Missouri,* by F. V. Reagel, Engineer of Materials, State Highway Department of Missouri; *Assuring Adequate Subgrade Conditions—Design and Construction,* by J. J. Forrer, Maintenance Engineer, Virginia Department of Highways; *Factors Governing the Selection of Asphalt Surface Types,* Lloyd F. Rader, Professor of Civil Engineering, University of Wisconsin; *Surface Treatment or Mat Construction,* Thomas E. Stanton, Materials and Research Engineer, California Division of Highways; *Roadmix or Travelling or Stationary Plant Mix,* by G. R. Logue, Chief Engineer, Location and Design, Ohio Department of Highways; *Cold Plant Mix or Hot Plant Mix,* by Henry L. Howe, Chief Engineer, Rochester, N. Y., and H. Walter Hughes, Supervisor, Tests and Materials, Division of Engineering, Rochester, N. Y.; *Asphalt in Stone Ballasted Railroad Track,* by John M. Podmore, Division Engineer, New York Central Railroad Company; *Discussion,* A. T. Goldbeck, Engineering Director, National Crushed Stone Association, Inc.

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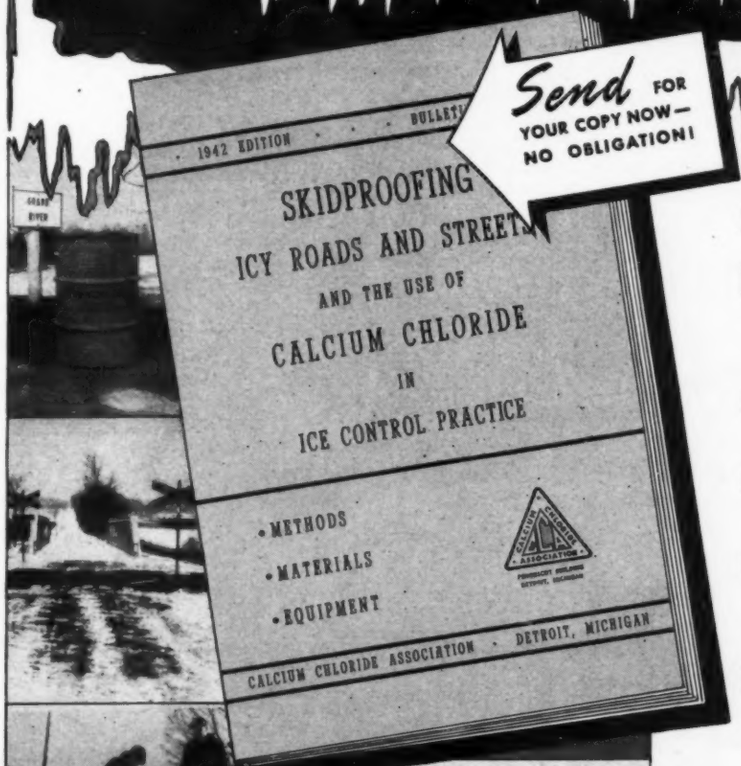

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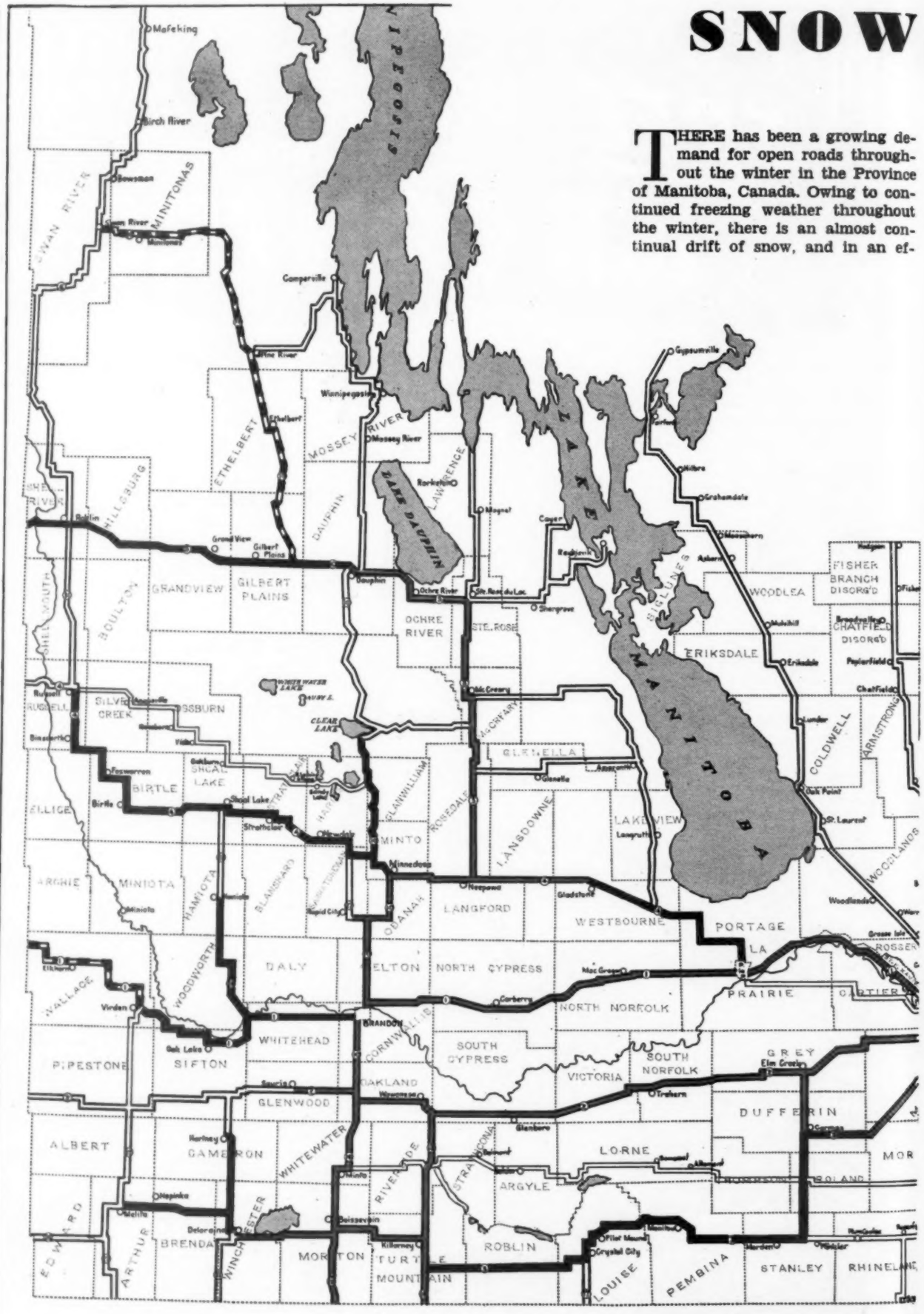
SNOW

THERE has been a growing demand for open roads throughout the winter in the Province of Manitoba, Canada. Owing to continued freezing weather throughout the winter, there is an almost continual drift of snow, and in an ef-



CONTROL WITH PLOWS
IN MANITOBA, CANADA

fort to reduce drifting of snow on the highways, grades have been constructed from 18 in. to 24 in. above the prairie. While this is quite effective in preventing accumulation of snow on the highway, it has certain objectionable features.

On older roads with lower grades, it has been necessary to erect snow fences on one side and in some cases on both sides of the right-of-way. Possibly four million lineal feet of snow fence would be required to effectively snow-fence the 2,077 miles of highway. To date, Manitoba has about 1,280,000 lineal feet of snow fence.

In the past five years the Province has been carrying on a system of planting hedges, in places where snow protection is needed, where the co-operation of the adjoining owners can be secured, and now have 1,232,-060 lineal feet of hedges. Some of these hedges have been erected for a sufficient time, that their effect is now being felt. It takes approximately five years before they begin to be really effective. Caragana has been the most used shrub for hedges, and these have mostly been obtained through the cooperation of the Dominion Forestry Station at Indian Head, Saskatchewan.

Snowplowing is carried out by means of nose plows and wings mounted on heavy four wheel drive trucks, and with rotary plows, to widen out drifts after they have been opened up by the nose plow. However, the ample use of snowfences greatly reduces the amount of snow plowing necessary.

During the past winter, over 1,000 miles of road were kept open fairly well throughout the winter, and an additional 1,000 miles kept open until early in the new year.

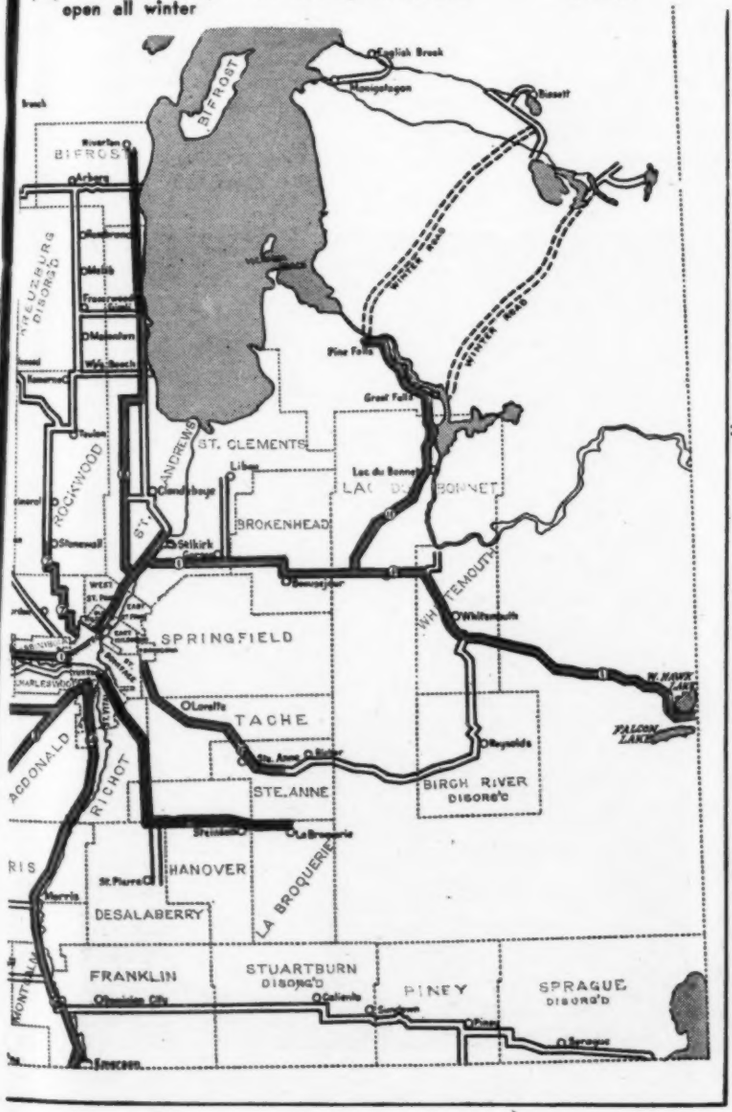
Legend

Black — Shows highway system of Manitoba

Red — Shows 960 miles proposed to be kept open all winter

Green (solid) — Shows 523 miles proposed to keep open to New Year or as long as feasible

Green (broken)—Shows 133 miles proposed to be kept open as long as feasible



PROPOSED DISTRIBUTION OF EQUIPMENT

District	No.	Type	Purchased	Description
Winnipeg	250	Gas	1934	Nose & Rotary
Winnipeg	217	Gas (Old)	1930	Nose Plow & Wing
Winnipeg	292	Diesel	1937	Nose & Wing
Winnipeg	254	Diesel	1936	Nose & Wing
Winnipeg	309-10	Gas	1939	Snogo
Winnipeg	311-12	Gas	1939	Snogo
Brandon	293	Diesel	1937	Nose & Wing
Brandon	218	Gas (Old)	1930	Nose & Rotary
Brandon	216	Gas (Old)	1930	Nose & Wing
Boissevain	286	Diesel	1936	Nose & Wing
Dauphin	272	Diesel	1935	Nose & Wing
Minnedosa	285	Diesel	1936	Nose & Wing
Portage La. P.	238	Gas (Old)	1931	Nose & Wing

First Annual North Central States Snow Conference

To encourage advancement in the field of snow and snow surveying and to further the practical application of knowledge now available, a conference is being called for central United States and Canada. Conferees will include hydrologists, meteorologists, agronomists, geologists, foresters, recreation and wildlife specialists, civil, utilities, highway, and agricultural engineers.

Those engaged in the preparation of the program feel that a maximum amount of time in the course of the one and a half or two-day meeting should be available for discussion. Therefore, it is planned to include a few formal papers, the greater part of the time to be spent in discussion of the subjects.

The Michigan Agricultural Experiment Station is sponsoring this first meeting of the North Central States Snow Conference, to be held December 11 and 12, 1941, at Michigan State College, East Lansing, Michigan.

Soils Density Apparatus Employs Rubber Balloon

FOR proper control of engineering construction involving the compaction of soils it is often essential that the density of the soil in place (weight of dry material per cubic foot) be determined at frequent intervals. In order not to interfere seriously with construction operations it is essential that the apparatus and procedure for obtaining the soil density afford both rapid and accurate results.

The Texas Highway Department in the past has been using the sand-cone apparatus for determining the volumes of test holes from which materials have been excavated as part of the density test procedure. In this method the volume of the hole is secured by filling it with sand of known weight per cubic foot. From the use of this apparatus several objectionable features have been observed and are listed as follows:

1. The necessity for calibrating, transporting and rescreening of a large quantity of sand.
2. Possible sources of error in the numerous calculations necessary for determining the volume of the hole.
3. The volume of the hole cannot be rechecked, once it has been filled with sand.
4. The considerable length of time necessary for making all the operations of the test.

Balloon Method.—Because of these objectionable features, the Materials and Tests Division decided to investigate the rubber balloon-water method of determining the volumes of test holes. Crude units were first tried and the theory proved. Later many improvements were developed and a rapid direct reading and generally more satisfactory method for obtaining density became available.

Figures 1, 2, 3, and 4 illustrate the final design developed and is believed to be the most practical apparatus of this type available at present. The water reservoir consists of a 24 in. cylinder, 4 in. in diameter, constructed of lucite which is transparent and non-breakable. This is fastened between two cast aluminum plates with a gage rod in the center of the cylinder to insure accuracy of readings when the apparatus is not exactly level. A rubber balloon is fastened to the bottom plate and an air vent valve and short length of rubber hose are fastened to the top plate. No. 20 paddle balloons, with necks removed (cost approximately $9.00 per gross) have proven satisfactory and durable.

The tube, less the volume of the gage rod and rubber balloon is calibrated for volumes varying by 0.0005 cubic foot up to 0.11 cubic foot and these volumes marked at the proper place on the gage rod. This maximum volume is sufficient for holes not to exceed about 1/10 cubic foot and their diameters may vary from 4 to 8 inches. When the apparatus is not

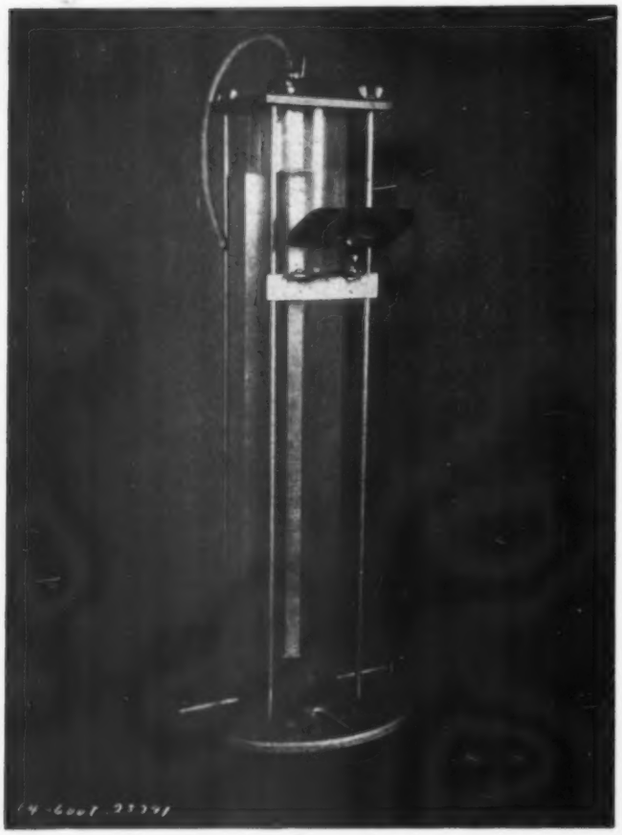


Fig. 1.—Rubber balloon density apparatus with lucite tube filled with water

Fig. 2.—Rubber balloon density apparatus after water has been allowed to pass from the lucite tube into the balloon

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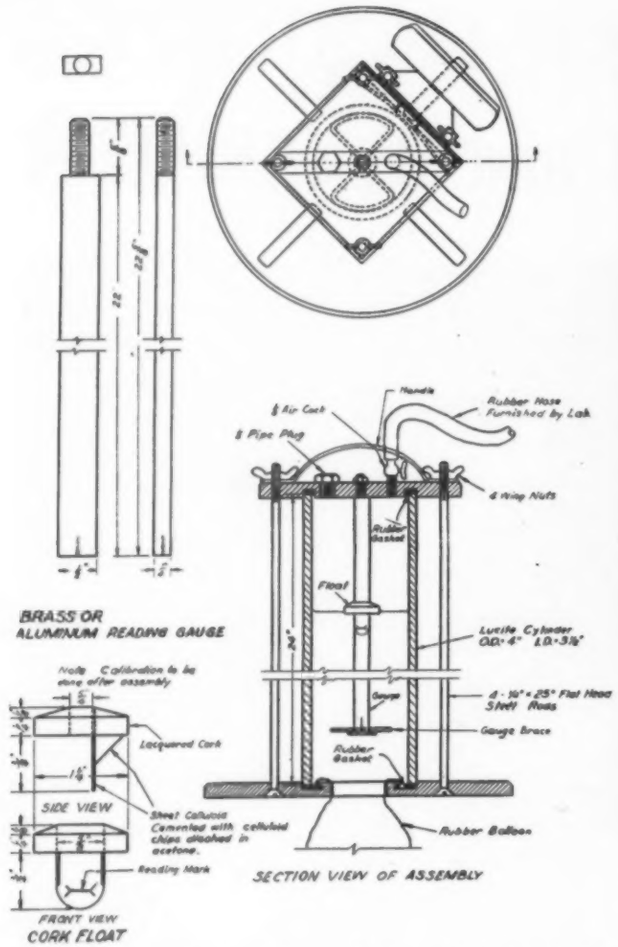


Fig. 4.—Working drawing of gauge, float, and assembly of soils density instrument

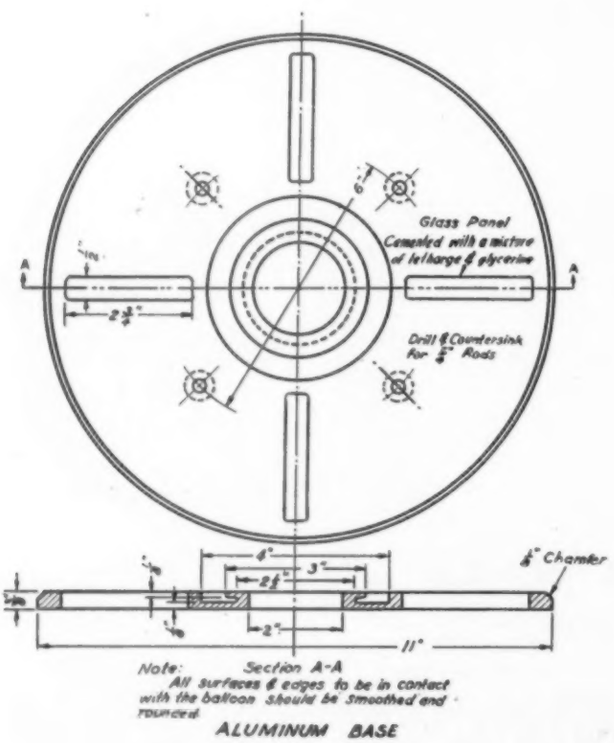

Glass Panel Cemented with a mixture of beeswax & glycerine
Drill & Countersink for ¼" Rods
⅛" Chamfer
Section A-A
Note: All surfaces & edges to be in contact with the balloon should be smoothed and rounded
ALUMINUM BASE

Fig. 5.—Detail of base of instrument

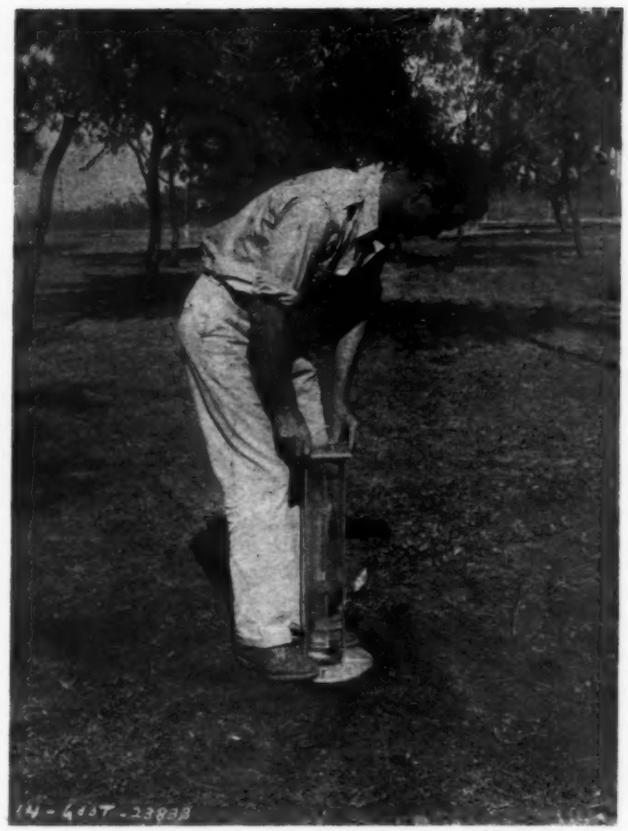


Fig. 3.—Determining volume of hole by use of the rubber balloon density apparatus. Note that by use of the rearview mirror one man is able to press the apparatus down flush with the surface of the ground with his feet, and at the same time make the necessary reading on the scale

in use, a vacuum is applied to the top of the cylinder and the air cock closed to maintain it. This draws the rubber balloon into the cylinder and protects it from damage. When the device is in use, an area of ground slightly larger than the base of the apparatus is leveled, the instrument seated, and a reading taken on this area before the hole is dug. This is the initial reading. The instrument is then removed, a hole dug and another reading taken with the balloon filling the hole. This is the final reading. To obtain the final reading the following steps are essential:

1. After placing the instrument over the dug hole, open the air cock and apply sufficient air

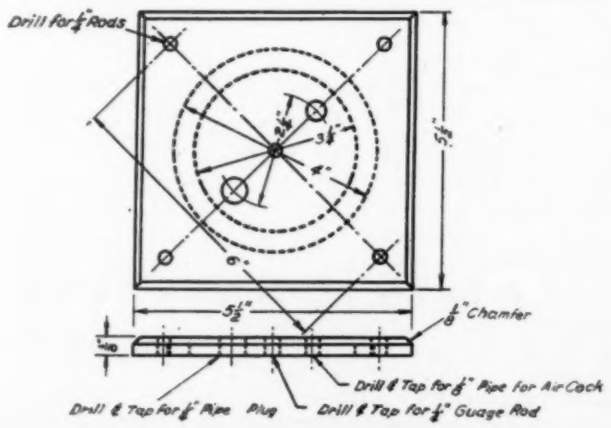
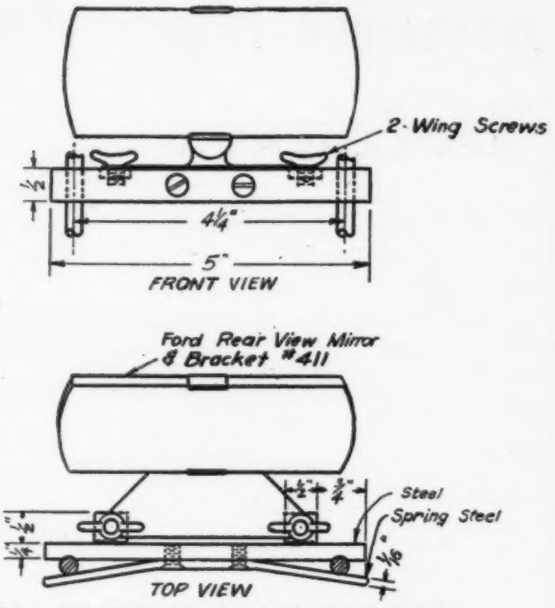


Fig. 6.—Detail of cap of instrument



DETAIL OF FORD REAR VIEW MIRROR ASSEMBLY

pressure from the lungs by blowing through the air hose, to raise the apparatus approximately ¾ in. above the ground.

2. Close the air cock.
3. Place both feet on the base plate to force it into contact with the ground and thereby force the rubber balloon to enter into the irregularities and the sides and bottom of the hole.
4. Properly adjust the mirror and take reading where the float line intersects the graduated gage rod. This reading will be under water which is a natural advantage in that the water magnifies the scale thereby enabling the operator to estimate readings to the nearest .0001 cubic foot.

The difference between the initial and final reading is the volume of the hole in cubic feet.

Credit.—This instrument was developed by the Materials and Tests Division of the Texas Highway Department. Mr. D. C. Greer is State Highway Engineer, and Mr. E. B. Cape was Materials and Testing Engineer at the time the apparatus was developed.

Gets A-3 Rating

The importance of highway transportation and the necessity of maintaining and expanding our highway system has again received recognition in the granting of an A-3 preference rating for the production of trucks and heavy trailers by O.P.M.

AGC Grants Charter to Colorado Highway Contractors

The Associated General Contractors of America has granted a charter as a chapter to the Colorado Association of Highway Contractors, Inc., Denver, Colorado. Mr. Charles B. Berry is President of this Association, with James B. Kenney its managing director. The membership of this newly affiliated chapter numbers 50 of the leading contractors doing highway and heavy construction work in the State of Colorado.

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American Equipment Speeds Philippine Defenses

By JAMES J. HALSEMA
Baguio, Philippines

TRADITIONAL hand-labor methods of building have been discarded by the many entities now rushing to completion the defenses of Luzon, principal island in the Philippines. Time is a vital factor in this huge project, for which $54,000,000 was recently appropriated, and which will represent an investment of several hundred million dollars when completed.

Airfields, highways, barracks, and forts, are some of the jobs in which modern American tractors, scrapers, power shovels, and similar mechanical equipment are being used. So successful have these machines proved in a country where pick-and-shovel work was almost the only way of building things previously, that the Philippine government is using such machinery on its new flood-control and irrigation projects.

Airport Construction

Pacific Naval Air Bases, Inc., [Henry J. Kaiser's company] which is building a series of nests for Uncle Sam's warbirds from Midway to the Philippines, is the largest user of power-driven equipment. Natives recruited from plowing rice fields with water buffaloes are now piloting huge diesel bulldozers, maneuvering heavy draglines, and doing pneumatic drilling. The Filipino, although not living in a mechanized country, has a good innate aptitude for handling machinery, and learns quickly.

At times the difficulties are tremendous. In a country where daily rainfalls of 15 inches are not uncommon, and the yearly average is over 145 inches, mud, floods, and water erosion are severe problems. During the past rainy season the author saw tractors working on the new field at Camp Ord, Tarlac Province, when people were fishing for the native mudfish or bafigus in the surrounding cane fields, so flooded were they. Camp Ord will be the Randolph Field of the Philippines, training several hundred Filipino pilots each year with American instructors and planes. Existing airports are being enlarged to meet the needs of the Flying Fortresses, P-40s. The country now has over 17 major military airports, and more than 75 other fields from which most planes can operate.

Highway Development

At the same time, the excellent highway network of the Philippines, now some 20,000 kilometers (12,000 miles) of all-weather road, is being extended in strategic areas, and im-

Everyone in the Philippines travels by car nowdays—a line-up of cars at the Baguio public market on a Sunday morning

The daring Baguio-Bontoc highway, chiseled out of a sheer limestone cliff by American and Filipina engineers, and G-stringed Bontoc warriors. Elevation 7500 ft. About 225 miles from Manila on Luzon Island

Modern cities like Baguio in the Philippines depend entirely upon motor transportation over modern paved highways. Baguio is 5000 ft. above, and 30 miles from the sea. It was founded by Americans in 1909

Erratic, raging rivers often change courses, destroying bridge approaches and sometimes the bridges themselves

The modern surface of the Manila North Road, 200 miles north of the Philippines capital. Note the unique rice granary on the left. This concrete road was built in 1940 with coconut-oil tax refunds

10,400 Guns for Merchant Ships from Steel Conserved by Preformed Wire Rope

★ It pays to use preformed wire rope. Being preformed this "rope" lasts longer—cuts the number of machine shutdowns—steadies production. It is easier, faster, safer to handle. It saves both time and money.

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★ The steel conserved *this year* by the longer service of preformed wire rope would be enough to build more than 10,400 3-inch caliber guns for merchant ships.

★ Preformed wire rope is an essential to industry, a necessity for the Nation.

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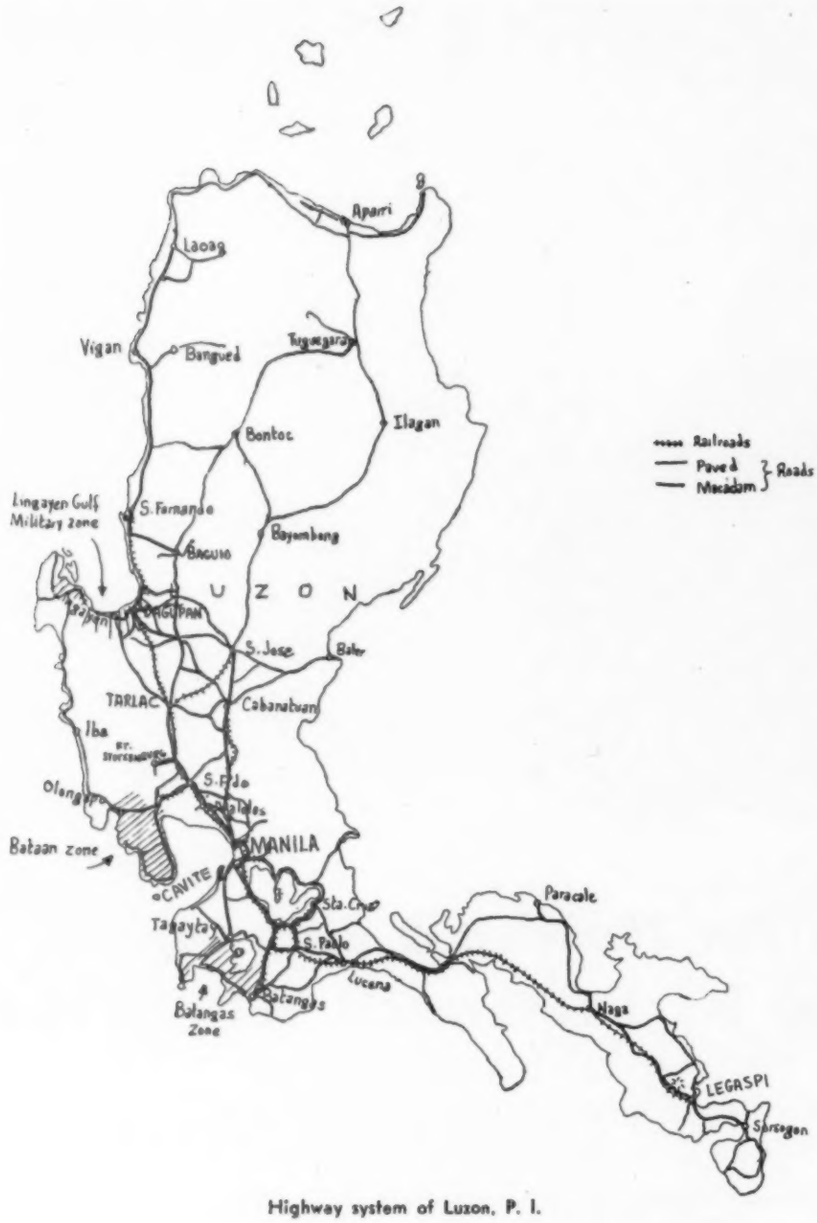
Ask Your Own Wire Rope Manufacturer or Supplier



Highway system of Luzon, P. I.

Spurred by military necessity, rivers like this one are being rapidly bridged to better serve Army vehicles which might rush to invaded points

Concrete paving, Manila-Tagaytay highway, built 1940. Original gravel road still visible in right lane. Elev. 2200 ft.

Toll bridge on one of the Philippines bridges

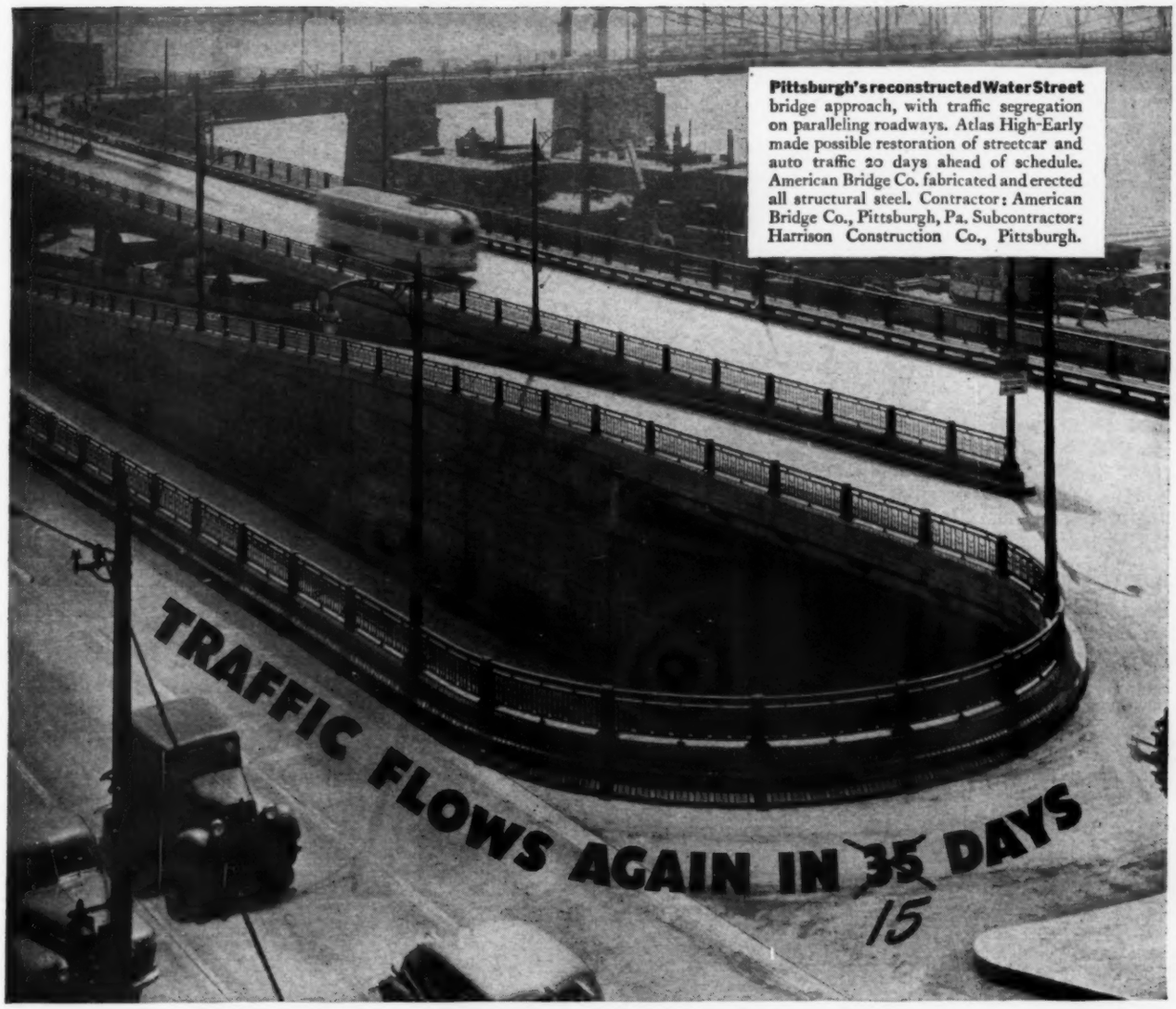
proved to bear heavy military traffic in other parts of the country.

Proceeds of the American excise taxes on coconut oil are returned to the Commonwealth government, which has put most of them into public works. Some 400 miles of concrete highway is built or building at the present time, although steel shortages are hampering further work. Cement is produced in the country. When roads are paved, temporary and narrow bridges are widened to a standard 20 ft. width, grades improved, and curves realigned.

Concrete roads last a long time in a country which has never seen snow, but much attention is given to the base and foundation problems. Standard procedure is to complete the base with a rough water-bound macadam surface and allow traffic to pound down the fill from twelve to eighteen months before paving with concrete.

Bridges are a perpetual headache for the Filipino highway engineer, for rivers in most of the country are like those in the southwestern part of the United States: dry most of the year, and raging torrents other times. Most of them are short and steep, bringing down debris from the nearby mountains which chokes channels and causes rivers to dig new channels with a perversity that prompted one harrassed engineer to suggest that his next expensive steel bridge would be built on rollers and hauled to the site of each annual river channel as it shifted.

Bridge building is expensive across the wide washes when it is considered that the Philippines operates on a budget of less than $45,000,000 a year in normal times. An initial revolving



Pittsburgh's reconstructed Water Street bridge approach, with traffic segregation on paralleling roadways. Atlas High-Early made possible restoration of streetcar and auto traffic 20 days ahead of schedule. American Bridge Co. fabricated and erected all structural steel. Contractor: American Bridge Co., Pittsburgh, Pa. Subcontractor: Harrison Construction Co., Pittsburgh.

20 DAYS SLASHED FROM CONCRETING SCHEDULE

—*with Atlas High-Early Cement!*

A CONTRACTOR got an idea . . and knocked a normal street construction schedule into a cocked hat! He got traffic moving almost three weeks earlier on Pittsburgh's vital artery. The Water Street project was just under way when he saw that Atlas High-Early cement could cut concreting time more than half!

Here's how he figured it. The whole section of pavement required five placements of concrete. Normal portland cement called for 7 days' protection and curing time on each placement . . . or a total of *35 days*.

But Atlas High-Early required only three days' protection and curing. So Atlas High-Early got the job . . . and finished it in *15 days*. Street cars and automobiles rolled again on Water Street 20 days sooner.

Specify Atlas High-Early cement for a cure in time that will save trouble and make money for *you*. Send now for new folder, "Case Histories of Days and Dollars." It shows you the benefits of this "speed-up" cement. Write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Dept. R-12, Chrysler Building, New York City.

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RS-H-33

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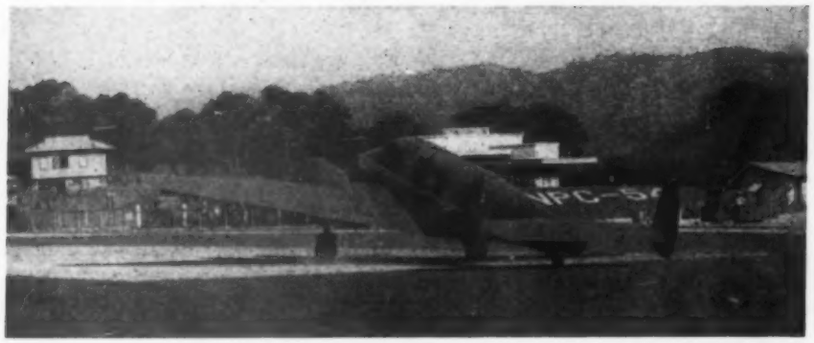
A UNIVERSAL ATLAS PRODUCT



Aided by American-made tractors and shovels, airports like this one in the mountains of Luzon are being enlarged for Flying Fortresses and other large bombers to defend the Philippines and strike back at any invader

fund of $5,000,000, appropriated by the Manila government almost 15 years ago, is used for building toll bridges, the proceeds of which are returned to the fund. In this way, scores of fine steel and concrete structures have been built, paid for, and declared free after several years. Tolls range from $0.05 to $0.50 for passenger cars; double for trucks and buses. Almost all steel bridges are standardized up to 160 ft. spans. Longest is the 2080 ft. structure across the Agno river on the Manila North Road, a vital strategic link.

Continued efforts are being made to improve the approaches to Manila, whose metropolitan area contains well over 1,000,000 people. Soft and swampy soil making mass air raid shelter impossible. Civilian Emergency Administration officials have prepared an evacuation scheme which will take scores of thousands of people out of the city in case of war and bombing attacks. Several super-highways, from 8 to 12 lanes wide, are now nearing completion to enable refugee traffic to proceed outside the city without interfering with military movements.

The pounding of Army traffic has necessitated repaving of many roads, but more especially the widening of routes which formerly were adequate. Scores of bridges have been rebuilt.

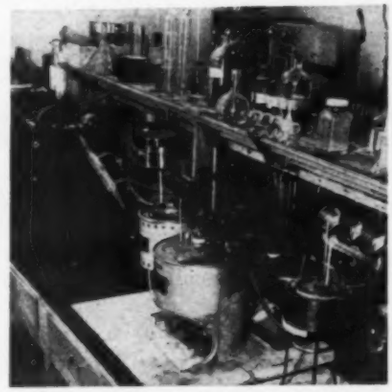
Even the leisurely tropical Orient succumbs at last to the power of American earth movers.

State Highway Laboratory of Alabama

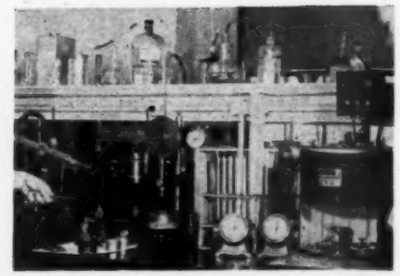
NO ROAD surface is better than the base on which it is laid or the materials which go into its construction. Testing, inspection and analysis of materials provide the data upon which judgments as to their use are based. A testing laboratory, rated as complete as any in the South is the Alabama State Highway Department laboratory which is under the direction of Mr. George P. Thigpen. The first laboratory was established in 1927.

As an example of the benefits to be obtained through testing it is claimed that if information on the strength of materials had been available when the Brooklyn and the Queensborough bridges were constructed in New York, they would not have been so massive; that considerably less material could have been used, thus reducing the cost, but losing nothing in strength. This was demonstrated, according to some, in the graceful span of the George Washington bridge across the Hudson River.

Showing how concrete cylinder is tested in a 200,000 pound compression machine. A failed cylinder is in the machine



Bituminous laboratory, Alabama State Highway Department



Chemist pouring up asphalt sample for testing

The Alabama State Highway Department tests all materials going into construction. The laboratory is divided into six separate units.

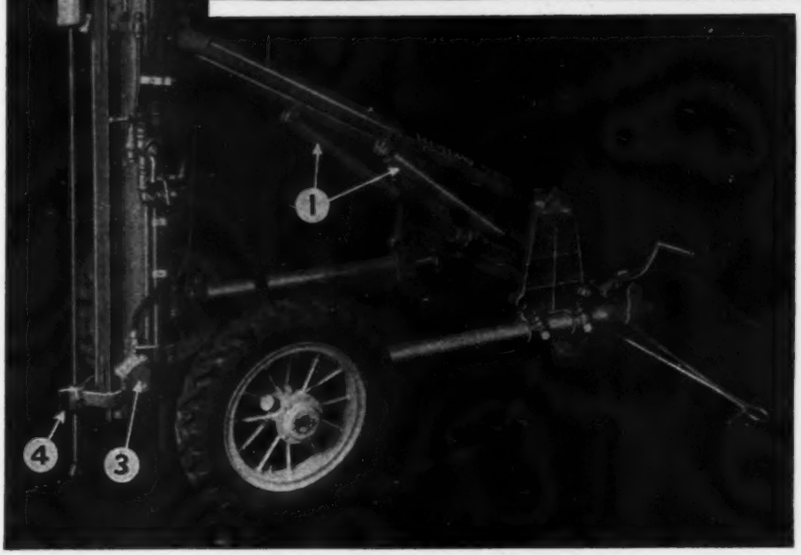
The physical laboratory tests reinforcing steel, portland cement, concrete and brick. There is a large compression and tensile machine in this department having a miximum capacity of 200,0000 pounds. The cement laboratory tests portland and puzzolan cements, water for concrete, sands and a few other materials. The chemical division analyzes paints, pigments, varnishes, metal pipe, stone and any material requiring a chemical analysis. The bituminous laboratory tests and analyzes the asphalt cements and oils, tars, creosote oils, expansion joint materials,

George P. Thigpen, testing engineer, Alabama State Highway Department

and any materials made from asphalt or tars to be used in highway construction. The soils laboratory, which is the largest of the units, tests soils for sub-grade and materials used in the construction of base courses for roads. This department is divided into three parts—mechanical, physical, and compaction. The general or aggregates laboratory makes tests of slag, gravel, stone, sand and kindred materials.

The state, according to Mr. Chris J. Sherlock, Director of Highways, has been able to save considerable money by using suitable materials which could be obtained close to the road to be built.

You who know CLEVELAND WAGON DRILLS



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What makes it better? Double-screw—geared together—U-Bar setting jack, smoother in action of raising or lowering. Center of gravity of the machine better placed; you can now get the toe holes without shifting the U-Bar on the frame. Slabback mounting for the drill facilitates economical renewal of worn guide parts. The DR30 can be placed, quickly and easily, in position for drilling any hole that the day's work may present.

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(2) Drifter mounted on a slab-back. The construction insures long wear of guides and more economical renewal.

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LEADERS IN DRILLING EQUIPMENT

Future Viewpoint Requires County Planning of Highways

By GEORGE M. HALEY

County Engineer, Salt Lake County, Utah

ABOUT twenty-five years ago, when highway construction in Salt Lake County and in the of Utah virtually began, there was such a strong demand for improved surfaces upon which to operate the new vehicle of transportation, the automobile, that little attention was given to any far-reaching principle of economics in the selection of roads for improvements.

So the result was that the individual or group that had the most influence with the bodies expending funds for these road improvements had the roads routed and built without a great deal of thought about the distant future. Therefore, in view of the meager knowledge of highway economics and engineering of that date and the further lack of any concept of what the motor vehicle would develop into, a major part of these first highways are now obsolete. Many of them have been relocated, or improved to better standards, but, in the majority, they fall short of being of sufficient design to provide the service which is necessary now and in the not-so-distant future.

On sections that have already been built, wherein widening and straightening are necessary to obtain proper design, wide rights-of-way must be acquired first. These rights-of-way (at present prices of land) and the removal of encroachments and other obstructions will require a large outlay of our road funds. So, in order to meet the situation now and plan for the future, designations should be made only upon the basic principles of highway economics without fear or favor of factions or groups.

It is recognized that under present financing plans properly planned highway improvements cannot be large and only the more important whole. Past experience and the problehs facing us now bring to us more forcibly than ever the necessity of proper planning in all of our local and state units of government.

Each county as well as the state has, in effect, ceased to operate as an individual and independent road building unit; they are now a part of a state-wide system of highway administration. No single unit can consider itself isolated or unrelated to the program as a whole. All units must sooner or later accept proven methods, methods than can and will bring economies and a better road system in our counties and the state as a whole, if and when applied. It is highly important that through proper administrative relationship proven successful methods should benefit all road building agencies in our state.

County, city and town officials are gradually discarding old-fashioned practices, and are adopting uniform methods as quickly as possible and employing more competent and trained personnel. They are beginning to agree that some plan of state-wide methods and standards in construction and maintenance, are desirable and necessary; yet, they are not favorable to any plan of centralization whereby the administration of local roads is further removed from local government. These officials are the guardians of programs concerning their local road matters; they recognize that responsibility, and frequently summon their influence for the preservation of their programs intended to bring benefits of road improvements to more of their cities, towns, communities, and homes.

Therefore, in order to set up a system of planning that will result in uniform state-wide benefits, that would result in uniformly efficient county, city and town operating units, that would uniformly develop all of the local streets, and the county feeder road mileage, there must be a close local-state government relationship, very much resembling the state-federal plan.

This should swing strong currents of public interest and support behind sustained road development programs. As there appears to be evidence that state-wdie planning, to be successful, must be founded on interest in the local communities and these interests must be given consideration.

Organizing for Planning.—Many activities are coordinated to organize a planning administration, and the following are some suggestions:

1. Organize local community planning boards to function and cooperate with city, county and state boards, to aid them by providing data and information on which to base intelligent planning.

2. Correlate various local plans which can, if necessary, be incorporated in state-wide master plan.

3. Study and make use of the Utah Highway Planning Survey and adopt recognized methods and principles in preparing programs. Call upon state, county and federal agencies for engineering and professional assistance.

4. Recognize the importance of engaging qualified assistance in preparing programs in order that projects may be set up in proper engineering form and recognize information available to determine how to properly finance same.

5. Study present state laws and local ordinances in setting up planning boards and revise local ordinances, if necessary, to operate and protect plans. Arrange for legislation necessary to carry out same.

6. Develop plans so as to use the resources of the community to best advantage.

It is desirable in order to appreciate the value and the economies that may be derived from planning to point out some of the experiences roads should be chosen, preferably in their sequence of importance to the *county and state system* as a encountered in highway development in this county. Just recently, in the widening of Main Street from 2100 to 3300 South, for instance, we found that Main Street from South Temple to 2100 South Street, was surveyed and laid out by pioneer engineers who anticipated the value of wide streets for future development and who procured a right-of-way of 132 feet. However, we found that the engineers and county officials who followed these pioneers did not carry out the wide right-of-way planning and permitted a 66-foot right-of-way

Mr. Haley's article, starting on this page, was given as an address before the Second Highway Engineering Conference of the University of Utah.—Ed.

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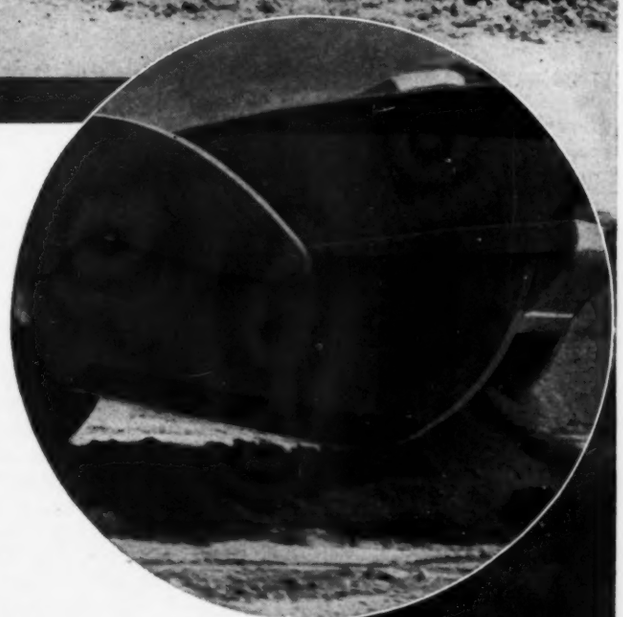

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KOEHRING HEAVY DUTY

HEAVY-DUTY CONSTRUCTION EQUIPMENT

to be established between these points (2100 South to 3300 South). The result has been that abutting property owners have crowded their improvements right up to the very edge of the right-of-way line, and now we have an 80-foot right-of-way in several spots with a five-foot sidewalk ending abruptly up against a building or other obstruction. In order that the public may pass they have to walk into the street and around these obstructions. The county is not financially able to pay the demands of sometimes exorbitant prices asked by property owners for the additional land needed to move and rebuild the expensive buildings. consequently there exists an eye-sore to community development, continued low land values, and unsafe driving and pedestrian safety condition with nothing much anyone can do about it.

This same condition of right-of-way was encountered by the state in the development of 2100 South Street from State Street to 1000 East Street. It cost the state $47,096.07 for right-of-way, damages and for removing and remodeling buildings. The total cost of this 1.4 miles of highway was $211,450.00, exclusive of the right-of-way cost and more than $100,000.00 of the total was for removing and replacing curbs and gutters, trees, walls and other units for widening the highway. It can be readily appreciated that this cost is far in excess of what it should have been if proper planning of the highway had been done a few years ago.

Rights-of-Way. — Pressure groups from cities and counties, and in many cases city and county officials, have made their contribution to this problem by insisting, very often against the wishes of highway officials, that highways be routed over certain streets and roads and through cities and towns instead of selecting a route that would be more suitable and economical for proper development in the future. This has resulted in such acute congestion of traffic in many of our cities and towns that the only apparent remedy now is to acquire at great expense the necessary land to widen such routes through such cities and towns or to construct new routes around them. All of these problems of inadequate rights-of-way for highway and street improvements are traceable to the lack of foresight in not having heretofore anticipated future needs more fully, to unduly restrictive provisions in state laws pertaining to highway rights-of-way and to the unfavorable attitude of some people towards proper planning.

Ordinances Needed.—In order to correct these conditions and to meet the problems of the future, planning boards should assist by encouraging adoption of laws and ordinances that will help in the elimination of some existing obstacles by:

1. Providing master plan for future development and in accordance with future state and federal plans.

2. Acquiring for future use as quickly as possible any public lands or local tax-deed properties that are to be used in future plans.

3. Empowering the county commissioners and highway departments to take posession of lands to be condemned in advance of completion of the condemnation proceedings.

4. Framing and enacting ordinances in cities, towns and counties to provide systems of zoning to apply along major highways, to protect bordering land from exploitation, and to safeguard the streets and highways against encroachments by advertising signs, buildings, businesses and other developments.

5. Enacting ordinances requiring set-backs for construction on present and future streets and highways involved in planning programs.

6. Enacting ordinances regulating the erection of utility poles, pipe lines and other public or private facilities on streets and highways.

7. Supporting and encouraging the beautification of present and future streets and highways by adopting an ordinance regulating the planting of trees and shrubs with standard types of trees, their location, protection and care.

8. Immediate adoption of subdivision ordinances in rapidly growing, rural communities adjacent to our large cities. This is important for the following reasons:

A. To have proper and uniform road and street widths.

B. To have proper road and street alignments and uniform intersections with existing or future roads and streets.

C. To prevent dividing of acreage into building lots, so arranged that they will block and interfere with future expansion or development of adjacent property, roads or streets.

D. To protect the buyer of lots in having a minimum area size. To reduce expense in surveys by having lots sold by number in subdivision instead of by meets and bounds from distant points.

E. To protect buyer from purchase of land not suitable for residential purposes.

F. To provide for proper street locations to avoid dead-end streets and roads or provide turn-around areas, to provide minimum grades and proper radii curves, pedestrian lanes, set backs, corner cut-offs, alleys, maximum block dimensions, trails, parking areas.

G. To provide standard size maps for proper filing with recorder and standard engineering practices for preparation of same.

H. To provide for standard development of roads and streets, and:

Road drainage
Grade and sub-grade preparation
Base and finish gravel
Surface finish
Curb-gutter, sidewalks, trees, etc.
Fire hydrant locations for proper fire protection.

Conclusion

Therefore, in conclusion, it would appear from the millions of dollars spent in this state by federal agencies, state, counties, towns and cities for the development and improvement of roads, highways and streets, and other evidence before us that we have not had proper planning. The cost of developments now to meet the traffic requirements is sufficient evidence that if we are to serve our people properly and look forward into the future as we should, planning must have immediate and proper consideration for the welfare and benefit of our communities.

Philip E. Fleming New Federal Works Administrator

President Roosevelt on Nov. 21 appointed Brig. Gen. Philip B. Fleming, Wage and Hour Administrator, as Federal Works Administrator, succeeding John M. Carmody, who recently resigned that post and since has been appointed a member of the Maritime Commission. The Public Roads Administration is a part of the Federal Works Agency.

New Edition of Manual of Steel Construction

The American Institute of Steel Construction has just published the fourth edition of the Manual of Steel Construction, a handbook for engineers and architects. This new edition contains considerable new data useful to designers and detailers of steel structures. This Manual is sold by the American Institute of Steel Construction at cost for $2.00 per copy.

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EDITORIAL

Discrimination?—Maybe

ELSEWHERE in this issue is an article by the chief chemist of the Colorado State Highway Department discussing their changed asphalt specifications and the reasons for making certain tests. That elusive factor, quality, is the characteristic of asphalt which asphalt paving technologists and chemists are pursuing. The change in the specifications is the insertion of a test for the viscosity index of the oily phase of an asphaltic road oil. Combined with the Oliensis spot test it discriminates between native petroleum asphalts.

The Public Roads Administration has given tentative approval of the viscosity index and it would be interesting to know the number of projects which the federal government has constructed in cooperation with the state under this specification. In the final analysis it is the record of satisfactory field service of asphalt as related to the new test that we wish to ascertain. To disclose this relationship and to satisfy itself that the viscosity index is a measure of quality, the government needs some specific projects upon which to base conclusions. They have, we understand, established an experimental project in which road oils were used from various sources with various viscosity indices of their oily constituents.

Only field service over a period of time will disclose whether or not the quality is satisfactory. Then by correlating the results with the viscosity index test one can evaluate the usefulness of this test.

To eliminate a product on the basis of its failure to meet the viscosity index test is arbitrary discrimination until field service of the product has definitely indicated that the test actually discloses unsatisfactory quality in asphalts. To make a decision upon laboratory considerations alone is short sighted judgment. Suppose in future products that the oily phase was reduced 50 per cent in quantity yet still showed a viscosity index below that specified. Is there any reason why this type of road oil would not give better field service than a road oil of which the viscosity index of the oily phase met the specification yet the volume of the oily phase was twice as much as the first road oil contained? This question cannot be answered by laboratory considerations alone. A field service test studied in connection with the laboratory tests is the logical procedure to follow upon which to base conclusions.

Paving in Freezing Weather

NOVEMBER first used to be the dead line for placement of the last batch of concrete for pavement. It still is in many specifications. We are pleased to see that Michigan has kicked aside this tradition even though under the pressure of national defense construction. Contracts let last month by the state call for construction of access roads to serve the Ford bomber plant at Ypsilanti. Concrete can be poured up to January first. As this is the first time that the state has attempted concrete road building in what is normally a period of freezing weather, the experiment will be watched closely by road contractors, engineers, equipment men and others identified with the industry.

Specifications provide that the aggregate and water used must be heated. Two pounds of calcium chloride per bag of cement is incorporated in the mix as a hardening accelerator and cold resistor. The grade will be protected against freezing by a two-foot straw blanket. The pavement will be covered with waterproof paper covered by blankets and a two-foot thickness of straw.

This part of the work will be the least troublesome. Freezing of stockpiles and aggregate hoppers will give the greatest trouble unless definite plans for their protection are made. Thanks to our many mechanical processes, mixing, placing, and finishing should give little trouble provided the concrete finishers can keep their hands warm enough for them to work conveniently. Undoubtedly the contractor will finish the grading before the surrounding terrain freezes.

English Confidence

MANUFACTURERS in England, who are serving the road building and construction fields, are demonstrating their confidence in the future. They are carrying full advertising schedules in English road building magazines regardless of the fact that they are hard at war and that steel for civilian supply is rigidly prorated.

This is an example worth investigation by American manufacturers. It indicates to the writer that "there'll always be a future" and that the British are going to be prepared to serve their markets after the rumble of the war drums have died out. English manufacturers may not be able to fill orders today but when the day comes that they can they will not lose one minute in so doing.

Caminos y Calles Makes Debut

THIS month the Latin American counterpart of ROADS AND STREETS made a successful debut. *Caminos y Calles*, pronounced kahmeenos ee kahlyás, means Roads and Streets in Spanish. The November-December issue is now in the mails. It is a civil engineering construction magazine designed to discuss civil engineering works and projects in all of the Americas. It will not be confined to articles on projects in South and Central America alone, but will be predominated by articles on practices employed in the United States.

The writer has talked to many engineers for highway departments in the Latin American countries. Without exception they stated that they would prefer such a magazine to contain information on the practical application of engineering theories and principles on projects in the states. These engineers, by no means, indicated that they preferred our methods. What they did indicate was that they wanted to keep abreast of what we were doing.

The reason for this request is quite evident when it is recognized that machinery, equipment, and materials from the United States are moving in larger and increasing quantities to our friendly neighbors to the south. There is a positive urge to complete the Pan American Highway. This will require machinery in those mountainous sections not yet completed. Our editorial advisor in Peru tells us that his country's section of the highway is complete and surfaced from border to border. The country is now planning extension into the interior.

New roads beget new development. Latin America is learning this rapidly. *Caminos y Calles* is designed to keep engineers and contractors informed on new methods and developments in the civil engineering construction field. It will be fairly closely confined to reporting on highway work until we become better acquainted with the readers. We invite you to send us articles for publication.

You'll speed up work!

When you order road steel from Bethlehem, work that's started goes along at a profitable clip. Working crews don't have to stand idle waiting for some key item to arrive, some material that's gone astray. Why is this?

Because Bethlehem handles orders for road steel as a single unit, plans shipments to meet your own working schedule, does its part to keep construction moving at a smooth, profitable pace. That smooth pace is a mighty big factor in getting jobs finished on time. Furthermore, Bethlehem Road Steel Service enables you to eliminate needless correspondence, extra phone calls, bookkeeping, accounting. And you are sure that each item of road steel you get is outstanding in design and quality.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

(Continued from page 54)

cumstances under which construction equipment can be purchased under Preference Rating Order P-22 AMENDED and Amendment No. 1 except as stated under question No. 1.

Question No. 3—In the event that repair parts cannot be obtained with an A-10 preference rating, the following procedure should be followed:

(a) Apply for a preference rating on form PD-1 in accordance with the instructions contained therein.

(b) Telephone or telegraph your requirements, giving nature of emergency and material required. Immediately mail your request on form PD-1 in order to receive confirmation of rating.

Question No. 4—A Governmental Agency may apply an A-10 preference rating for repair and maintenance material and operating supplies for equipment under lease. The preference rating must be initiated by the Governmental Agency if terms of the lease require that Agency to keep the equipment in sound condition. Should the terms of the lease contain a clause in which the owner or lessor guarantees to keep the equipment in sound working condition, the A-10 preference rating must be initiated by the lessor.

Question No. 5—Amendment No. 1 to Preference Rating Order P-22 AMENDED includes contractors under (b) (1) iii, "Producers," and as such is assigned an A-10 preference rating for their repair, maintenance and operating supplies.

Very truly yours,

(Signed) Arthur M. Wolff

Arthur M. Wolff, Analyst

Maintenance & Repairs Branch

Priorities Division

About Contractors and Their Jobs

St. Louis Area

REPORTED BY

O. B. AVERY

$3,700,000 FUND SOUGHT OF PWA FOR WIDENING ACCESS ROADS IN ST. LOUIS.—Charles H. Ellaby, president of the Board of Public Service, presented applications to Public Works Administration officials in Washington for an estimated $3,700,000 for 15,000 lineal feet of widening and 12,000 lineal feet of new construction in the northwestern part of the city, to provide access roads to the projected new Airport Highway. The applications are made under the Lanham Act, appropriating Federal funds for public improvements in connection with defense. Four grade separations are planned—at the Bircher-Terminal crossing, at Hodiamont and Natural Bridge, at Hodiamont and Terminal tracks, and at Goodfellow and Saloma. Roadways connected with this work will add several hundred feet to the lineal figures given.

▼

$8,500,000 PLAN FOR DEFENSE ROAD SYSTEM IN MISSOURI.—Plans for an $8,500,000 road construction and improvement program, to provide the Missouri portion of a proposed national defense highway system, were outlined to the Engineers' Club of St. Louis, in a paper prepared by Carl W. Brown, chief engineer of the Missouri State Highway Dept. Most of the projects in the program are for roads in the vicinity of Missouri army posts—Jefferson Barracks, Fort Leonard Wood and the new Camp Crowder, near Neosho—and of airports, defense material plants and other Government establishments.

▼

U. S. TAKES 1149 ACRES FOR FORT WOOD AIRPORT.—The government took possession of 1149 acres of land at Vichy, Missouri, for a military airport to serve the Fort Leonard Wood area, by filing a declaration of taking in Federal Court and paying into the court registry $57,450.00 for the property. The airfields will be situated on the northeast intersection of Highways 63 and 28, about 20 miles northeast of Rolla, Missouri, and will have two runways. Details as to the number of men and planes that will be stationed at the post have not yet been announced.

▼

CONTRACTS AWARDED AND LOW BIDDERS ON MISSOURI WORK.—McCarthy Bros. Construction Co., St. Louis, were awarded contract at $61,340.00 for the construction of camp structures at Fort Leonard Wood.

Don P. Pray, Monett, Mo., was low bidder at $97,500.00 for the construction of a sewage disposal plant and deep well at Waynesville, Missouri, on bids opened November 14th by the Defense Public Works Div. of Federal Works Agency. Pray was also low bidder on the sewage disposal plant at Rolla, Mo., his bid being $114,100.00.

John Epple Construction Co., Columbus, Mo., was awarded contract for the construction of a recreational center at Waynesville, Mo., at approximately $80,000.00.

Following were awarded contract on state road work by Missouri State Highway Dept. on bids opened October 24th:

Ebbe Construction Co., Trenton, Mo., 0.225 miles of grading, bridge and surfacing in Davies County—$33,331.00.

Oscar H. Schmidt, St. Joseph, Mo., 0.077 miles of grading bridge surfacing in Gentry County—$33,883.00.

L. W. Hayes, Bethany, Mo., 2.159 miles of grading and surfacing in Worth County—$13,941.00.

L. W. Riney, Hannibal, Mo., 3.433 miles of grading bridge and surfacing in Adair County—$45,568.00.

Royce Zink, Appleton City, Mo., 3.756 miles of grading and bridge in Johnson County—$20,568.00.

Royce Zink, Appleton City, Mo., 0.038 mile of culverts in Johnson County—$403.00.

Frank Trager, Braymer, Mo., 1.799 miles of grading and surfacing in Lafayette County—$9,260.00.

Booth & Olson, Sioux City, Iowa, 1.587 miles of grading and 22′ concrete paving in Caldwell—$55,204.00.

Booth & Olson, Sioux City, Iowa, 4.490 miles of grading and 22′ concrete paving in Ray County—$182,497.00.

Otto W. Knutson, Kansas City, Mo., 0.076 mile of grading and culverts in Howard County—$5,747.00.

American National Construction Co., St. Louis, Mo., 8.445 miles of grading in Gasconade County—$110,914.00.

Royce Zink, Appleton City, Mo., concrete culverts in Barry County—$12,386.00.

J. M. Roark, Anderson & Poole Construction Co., Kansas City, Mo., 4.553 miles of grading, bridges and 22′ concrete paving in McDonald County—$273,238.00.

O'Dell & Riney, Hannibal, Mo., 3.270 miles of grading and concrete paving in Greene County—$199,681.00.

Carrothers & Crouch, Kansas City, Mo., 0.872 miles of grading, bridge and 22′ concrete paving in Polk County—$124,803.00.

Royce Zink, Appleton, Mo., 2.994 miles of grading and surfacing in Webster County—$17,797.00.

W. J. Menefee, Sedalia, Mo., 2.619 miles of grading, etc., in Reynolds County—$29,655.00.

Carrothers & Crouch, Kansas City, Mo., 0.189 miles of grading, bridge and gravel in Ozark County—$50,727.00.

M. E. Gillioz, Inc., Monnett, Mo., 4.694 miles of grading and 22′ concrete paving in Wright County—$255,025.00.

O'Dell & Riney, Hannibal, Mo., 1.837 miles of grading in Bollinger County—$11,918.00.

CONTRACTORS AND HIGHWAY OFFICIALS SPEAK—

"QUOTATIONS" from

CONTRACTORS—

OFFICIALS

County—

Your equipment specifications are very valuable ..... Vermont
It's a great book. Thanks for our copy ..... Iowa
There is never a day goes by but the book is in constant use in my office ..... Illinois
Every manufacturer should be in ..... Oregon
Very well covered for my purpose ..... Virginia
If coverage is as great in 1941, we shall be well pleased ..... Kansas
Have found equipment specifications very helpful, and have found a place for the Catalog close to my desk ..... New Jersey
Handy to locate manufacturers of different products, also make use of the construction data and tables ..... Kansas
Adequate and has all we need ..... Texas
Ground very well covered ..... Washington

State—

We find it of much assistance and use it frequently ..... Alabama
Catalog is in almost constant use in my office as a reference ..... Illinois
An excellent publication, containing valuable engineering data ..... Tennessee
You now have a good list of manufacturers and the data is more complete and better than ever before ..... Vermont
Heads of departments, city, county, WPA and contractors very often come to us for consultation and we find this book invaluable ..... Texas

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It is satisfactory and complete for our requirements ..... Ohio
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You have covered the field very completely .... U. S. Engineer's Office, Texas
This office is interested in obtaining two copies of the catalog ..... U. S. Engineer's Office, New Hampshire
It is requested that copy of Powers' Catalog be furnished this office—the one previously sent to us was forwarded to one of our secret Atlantic bases ..... U. S. Engineer's Office, New York
Please send copy of Catalog to me at above address ..... Area Engineer WPA, Louisiana

POWERS' ROAD AND STREET CATALOG

330 SOUTH WELLS STREET, CHICAGO, ILLINOIS

NEW YORK • CLEVELAND • SAN FRANCISCO

Porter De Witt, Wapello, Mo., 1.888 miles of grading, bridge and gravel in Madison County—$21,582.00.

W. J. Menefee, Sedalia, Mo., 3.407 miles of grading and bridge in Ripley County—$37,252.00.

Ray & Son, Louisiana, Mo., 4.394 miles of grading in Wayne County—$18,739.00.

CONTRACTS AWARDED AND LOW BIDDERS ON ILLINOIS WORK.—Among the low bidders at the November 18th letting of the Illinois State Highway Dept., were the following:

Earl Walker, Sullivan, Ill., approximately 6.79 miles of oiled earth in Perry-Franklin Counties—$12,563.00.

H. P. Eppel, Pontiac, Ill., 1.30 miles of grading in Scott-Greene Counties —$21,412.00.

Waukegan Construction Co., Springfield, Ill., reinforcing concrete girder bridges northeast of Felter in Greene-Morgan Counties—$40,691.00.

Stiers Bros. Construction Co., St. Louis, Mo., were low bidders at $543,-088.00 covering the construction of Flood Protection Works at Mound City, Ill., by the U. S. Engineers.

Longwill-Scott, St. Louis, Mo., were awarded contract at $16,574.00, covering railroad tracks and switches at Rockfot, Ill.

S. W. Hardwick, Beardstown, Ill., has been awarded contract at $347,-509.00 for levee work in Monroe County, Ill., by the U. S. Engineers, St. Louis.

Nielsen Bros., Onawa, Iowa, were awarded contract at $15,028.00 for levee work at Rock Island, Ill.

Montana Area

REPORTED BY

L. E. JONES

On Nov. 25 the Montana State Highway Commission at Helena, Montana, opened bids on 13 highway projects. The total amount of the projects awarded, calls for an expenditure of $1,119,741.99. Another highway letting was announced by Chairman A. F. Winkler, for January, 1942.

The projects and successful bidders of the 13 highway jobs were:

1. Construction of a concrete sidewalk and subsidiary work on the Yellowstone River bridge and approaches at Glendive: John Holm, Glendive, $17,783.26.

2. Grading, surfacing with crushed gravel and drainage structures on 9.454 miles of the Big Timber-Harlowton road in Sweetgrass and Wheatland Counties: Nilson-Smith Construction Co., Great Falls, $157,-149.86.

3. Construction of two timber bridges and three stockpasses, a concrete bridge and widening of a concrete and steel bridge on the Big Timber-Harlowton Road: Union Construction Co., Great Falls, $30,865.96.

4. Grading, surfacing and oiling on 4.865 miles of the Hardin-Custer Road in Big Horn County: Albert La Londe, Sidney, $92,875.97.

5. Construction of five timber bridges on the Hardin-Custer Road: W. P. Roscoe, Billings, $14,292.94.

6. Regrading, surfacing and oiling 1.858 miles of the Chateau-Sun River Road in Cascade County: E. O. Howe, Great Falls, $40,461.01.

7. Regrading, gravel surfacing and oiling 3.212 miles of the Missoula-Clinton Road in Missoula County: Union Construction Co., Great Falls, $257,816.25.

8. Grading, gravel surfacing and drainage structures on 5.187 miles of the Bonner-Onardo Road, Missoula County: L. A. Woodward, Missoula, $93,598.12.

9. Construction of a concrete and steel bridge, four timber stockpasses and a concrete box culvert on the Bonner-Ovando Road: Cahill-Mooney Co., Butte, $30,917.04.

10. Gravel and bituminous surfacing of 18.995 miles of the Jordan-Circle Road in McCone County: Albert La Londe, Sidney, $124,988.90.

11. Grading, gravel surfacing and oiling of 13.049 miles of the Roundup-Forsyth Road in Musselshell and Rosebud Counties: Peter Kiewitt Sons Co., Omaha, Nebraska, $216,955.30.

12. Blading of subgrade, gravel surfacing and drainage structures on 7.281 miles of the Billings-Broadview Road in Yellowstone County: Charles Shannon, Butte, $29,377.10.

13. Gravel surfacing of 4.476 miles of the Avon-Helmville Road in Powell County: Frank J. Haas, Great Falls, $12,660.28.

Gov. Sam C. Ford of Montana named A. E. Kathan, Brady, former democratic candidate for governor, and a leader in the Farmers Union movement, as State Highway Commissioner of District No. 3. He replaces E. O. Coolidge, Great Falls, who declined the appointment. Kathan's term is until July 1, 1945.

H. M. Doolen, president of Western Construction Co., Billings, was elected president of the Montana Equipment Distributors; Frank G. Connelly, president of Connelly Machinery Co., Billings, was elected vice-president, and L. E. Jones, president Hall-Perry Machinery Co., Butte, was elected secretary-treasurer, at a semi-annual meeting of the organization at Helena on Nov. 25. Two directors will be appointed, and they with the officers will comprise the executive committee. The membership of the Montana Equipment Distributors are as follows: J. D. Adams Co., Billings; Connelly Machinery Co., Billings; Hall-Perry Machinery Co., Butte; Midland Implement Co., Inc., Billings; Mountain Tractor Co., Missoula; Petrie Machinery Co., Billings; Steffeck Equipment Co., Helena; Tractor & Equipment Co., Sidney; Western Construction Equipment Co., Billings; and Westmont Tractor and Equipment Co., Missoula.

Bids on improvement of the Monarch Canyon section of Y-G Bee Line Highway, near Monarch, Montana, will be opened on December 10, 1941, by Public Roads Administration at Missoula, Montana. The section of road to be improved or reconstructed extends for 3.68 miles.

L. J. Birbeck of Helena was awarded a 3000-ton crushed gravel contract by Lewis and Clark County Commissioners of Helena. The crushed materials are to be plant mix aggregates and of Montana State Highway specifications. The crushed aggregates will be stock piled and used in 1942 for maintenance of county oiled roads and additional section.

Michigan Area

REPORTED BY

J. M. TELFORD

Michigan Is Ready.—Passage of the Defense Highway Bill, and the President's action in signing it, undoubtedly means a considerable increase in highway construction in Michigan during the coming year. G. Donald Kennedy, State Highway Commissioner, has announced that the state is prepared to match any funds allocated to it under the new 75-25 match formula, and has plans ready for immediate action when the Federal money is made available. Michigan is an important center of defense industrial activity, in addition to its military activity around Fort Custer, Selfridge Field and other army and air camps. The first military highway in the country was built by the State Highway Department in Fort Custer. One of the most pressing highway problems in the state at present concerns construction of a network of roads to serve the new Ford Bomber Plant, now nearing completion just east of Ypsilanti. The State Highway Department and the county road commissions of Wayne and Washtenaw

Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan | helps workers provide for the future | helps build future buying power | helps defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will*.

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

Plenty of help available. Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.

France left it to "hit-or-miss" . . . and *missed*. *Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

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Treasury Department, Section A,
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Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

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Position _____

Company _____

Address _____

GPO 425498

counties are co-operating in this project, which is expected to result in a total expenditure of nearly $5,000,000.

New Road Dedicated. — E. R. Luedtke, Frankfort contractor, was in charge of ceremonies at the dedication of the new section of the diagonal highway M-115 between Mesick and Benzonia. Commissioner Kennedy wielded an axe to sever a cord stretched across the road. Civic leaders from municipalities along the highway attended a banquet in Frankfort following the dedication. Contractors having parts in the construction of the new section included Johnson and Greene, Pickett & Goodwin, and the Bridgeport Core Sand Company.

A Bad Fire.—Fire destroyed a large building just south of the Lansing city limits, owned by Ray Sablain, Lansing road contractor. Mr. Sablain's office was in the structure, the largest portion of which was occupied by the Lansing branch of the International Harvester Company.

Plans for 1942. — The Ingham County Road Commission plans to blacktop about 57 miles of roads and platted streets during the coming year, according to its recently-approved budget. During 1941, 61.3 miles of blacktop was laid, bringing the county's total of this type of surfacing on its roads and streets to 538.6 miles. The 1942 budget also calls for 15 miles of grading and graveling; bridge construction estimated at $25,000; maintenance, $200.000; new equipment, $35,000; extensions to the Maso ngarage, and other items. J. G. Rakowsky is County Road Engineer.

Bedford Township Ceremony. — Federal, state, county and township officials took part in the dedication of the new Bedford township (Wayne County) water and sewer systems. Michael J. O'Brien, vice chairman of the Wayne County Road Commission, was in charge of the program, wrich included talks by John F. Breining, member of the commissoin; Abner E. Larned, State WPA Administrator; W. F. Shepherd of the State Department of Health; and Victor E. Anderson, township supervisor.

Contracts Have Been Awarded.— Contracts for grading and paving on roads leading to the Ford Bomber plant have been awarded recently to H. H. Frisinger, J. H. Porath & Sons Company, and E. B. Schwaderer; Denton Construction Company; E. B. Schwaderer, and the Oak Construction Company.

Re-elest Walter Dow. — Walter Dow, Emmet County Road Engineer, has been re-elected president of the 29th District Road Commissioners Association.

Bridge Completed.—Walter Toebe & Company has completed, six weeks ahead of schedule, the widest bridge ever built on the Michigan state trunklin system. It has an overall width of 75 feet, 2 inches, and is to be a part of a divided-lane re-location of US-31 around South Haven.

Pittsburgh Area

REPORTED BY

JOHN W. PATTERSON

Airport in Moon (township) Allegheny County, Pittsburgh, Pa. — In the past two issues of this magazine we covered information in connection with the proposed Airport for Allegheny County. The selection of the site has been made and the property approved covers 1100 acres in Moon Township, most of the acreage involving the John A. Bell Estate. The site was selected by the Civil Aeronautics Authority after a wide and extensive survey of eight proposed locations. The Allegheny County Commissioners were notified November 19th by the C.A.A. The Commissioners instructed the County Legal Department to immediately make arrangements for the purchase of the $200,000 site.

25—Roads and Streets gor 11-27

The new airport will be about fifteen miles from the heart of the City of Pittsburgh, and will be the second modern airport to be constructed in Allegheny County. The government has allocated $2,600,000 for the building of the project, and the County of Allegheny are purchasing the required property.

In notifying the County of the approval of the site, Albert H. Wessell, District Airport Engineer for the C.A.A. is quoted as follows: "The government desires to proceed with the construction of the Airport at the earliest possible date, and the co-operation of the Commissioners in advising us of the approximate date when the land can be made available will be appreciated so that preparations of plans and specifications, advertising for bids, and the awarding of contracts can be proceeded as rapidly as possible."

The new airport will have three runways each nearly one mile long with sufficient acreage provided with further extension of a length of 50 feet wide and paved to a width 7,000 ft. The landing strips will be of 150 feet along their entire length.

The work will involve several hundred cubic yards of grading, together with considerable paving and hanger construction. It is reported this project will be built under the supervision of the U. S. Engineers in Pittsburgh, and the work will be awarded to private contractors on a competitive bidding basis. It is expected within 30 to 60 days proposals will be asked for the construction.

Defense Project.—The U. S. War Department has announced the construction of a $40,000,000 Defense Plant at Geneva, Penna. This plant will be known as the Keystone Ordnance Works. Indirectly we understand the project will be constructed by Frazier-Brace Engineering Co., Wilmington, Del. This is one of the largest Ordnance Plants to be undertaken in the State of Pennsylvania. It is expected the work will be underway before this issue goes to press. The project will probably be finished before the summer of 1942. Considerable heavy building construction will be involved as well as excavation, grading and concrete work.

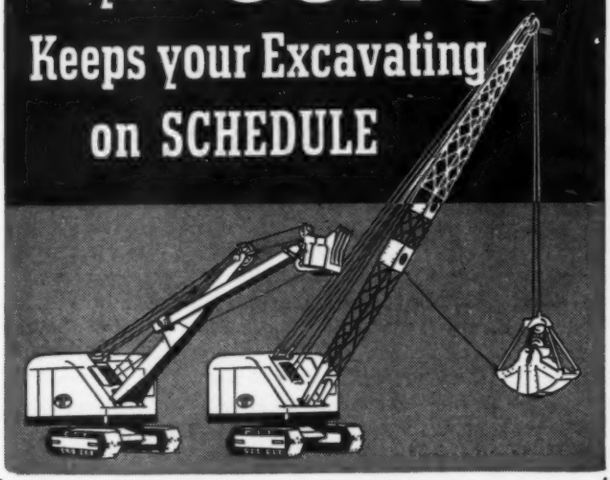
Expansion and How! — Carnegie-Illinois Steel Corporation's $70,000,-000 addition to the Homestead Mills is now underway. The Monarch Wrecking & Lumber Co. of Detroit, Mich., have been awarded the huge razing contract and are going forward 'On the beam." The razing contract calls for a sixty-day dead line. Austin Givens a well known contractor of Pittsburgh, Pa., is subbing some of the demolition work.

Some difficulty is being encountered in tearing down the houses by not getting the occupants to vacate. There are about 500 men employed in the demolition work. The salvage will amount to $500,000.

Nearly half of Homestead's 19,000 population is being evacuated by the plant expansion. The new plant we understand will be owned by the government and operated by the Carnegie-Illinois Steel Corporation. After demolition of site, the new plant will start to take form. Considerable general excavation, foundation excavation and concrete structures will be under way within sixty days and the superstructure will be rushed with all possible haste.

Mahoning Dam, Deerfield, Ohio.— The U. S. Engineers Office at Pittsburgh, Pa., will ask sealed bids in duplicate until 11:00 o'clock A. M., Eastern Standard Time, December 18, 1941, and then publicly open, for furnishing all plant, labor and materials, except certain items of equipment furnished by the Government and performing all work required for the construction of a concrete and earth dam and appurtenant structures indicated on the drawings or required by the specifications for Ber-

Byers OUTPUT Keeps your Excavating on SCHEDULE



Byers excavators are well known for their ability to get maximum yardage every day. With Byers shovels, it's the snappy, accurately controlled independent chain or cable crowd that does it.

Line and swing speeds are fast, and synchronized, to get a shovel dipper up and out, ready to dump, by the time the boom has swung over the truck into dumping position.

With Byers cranes it's their ability to swing while traveling.

This is another reason why you should investigate Byers.

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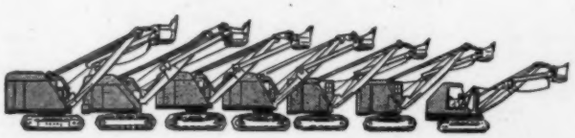

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Change from Wheels to Tracks

in 10 seconds

At left—Wheels retracted by the pull of one lever. Machine operating on LINN Haftrak.

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Every Day All Winter

Every Day All Summer

Here is the year-round machine ready to go as a truck at high speed over boulevards—then as a Haftrak to work where others mire—ready to pack its own load and pull other equipment or to remove deep snow and drifts. Send for a Model C-5 Specification Sheet for details about this year-round, terrain-covering machine.

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CONTOUR-FOLLOWING TRACTION

HAFTRAK

lin Dam on the Mahoning River. The site of the work contemplated herein is in Mahoning and Portage Counties, Ohio, on the Mahoning River, a tributary of the Beaver River. The site of the work is located approximately one and one-half miles downsteam from the Bridge on the U. S. Highway Route 224 crossing the Mahoning River, between Berlin Center and Deerfield, Ohio. Class A-2 priority rating is applicable to the work contemplated herein.

Kansas City Area

REPORTED BY

PAUL L. MATCHETTE

Rex Whitton Handles a Big Job.—The Missouri State Highway Department maintains 16,060 miles of roads divided as follows: Concrete highways, different widths, 4250 miles; bituminous surfaces, different widths, 3,420 miles; gravel or stone roads, different widths, 8217 miles; oiled and graded earth roads, different widths, 172 miles. Mr. Rex Whitten is the engineer in charge of maintenance for the Missouri State Highway Department. Rex not only has a wonderful disposition but is a diplomat par excellence. Throughout the State he is well liked. In our travels we have not had one occasion during the past several years to hear anything but praise in regard to the fine job he is doing in maintaining the State Highways.

Feeney Brothers.—When contractors think of St Joseph, Missouri, they think of Feeney Brothers. Ben Feeney owns and operates the Feeney Construction Company at Seventh and Olive Streets. Ray Shriver is Vice-President and Engineer in Charge of Construction. The Feeney Construction Company own and operate an asphalt plant and also own and operate a central Portland Cement concrete mixing plant ,including a fleet of truck mixers. Besides furnishing asphalt and Portland Cement concrete they do considerable sewer work and the building of engineered structures. Besides operating in the City of St. Joseph they also operate throughout the northwestern part of Missouri. They own and maintain a complete grading outfit; also a complete oiling and graveling outfit. Both Ben and Ray are hard workers. They are on the job early and late. This is one of the many reasons why they have been so successful in the construction industry.

Charlie Feeney owns and operates the Pioneer Sand Company at the foot of St. Francis Street, on the Missouri River. This sand plant is one of the most modern in the State of Missouri. Not only do they furnish the City of St. Joseph and the surrounding territory with most of the sand used, but also they are large shippers throughout the surrounding area.

Airport Construction Continues.—The U. S. Engineers at Caddoa, Colorado and Tulsa, Oklahoma, are taking bids on a number of CAA Airports throughout the Kansas City area. Below are the Engineers' estimates, the first and second low bidders on Dodge City, Kansas Airport, Clovis, New Mexico Airport, and Joplin, Missouri Airport. The runways on these three airports were stabilized base with hot asphalt top. Dodge City, Kansas, was an eight-inch compacted Caliche base with a two-inch hot asphalt surface. Clovis, New Mexico, was a nine-inch compacted Caliche base with a two-inch hot asphalt surface. Joplin, Missouri, was a six-inch lean cement concrete composed of three sacks of cement to the cubic yard of lead and zinc tailings with a one and one-half-inch hot asphalt surface.

Kansas City Gets Low Bid.—The Midwest Paving Company of Kansas City, Missouri, owned by Frank L. Carswell, President of Missouri AGC, has just recently been awarded a contract for 400 tons of sheet asphalt at $7.14 a ton. Tobin Asphalt Products, Inc., of Kansas City were second low bidders at $7.25 a ton. This sheet asphalt is purchased by the street repair department of Kansas City, Missouri, for street repair work.

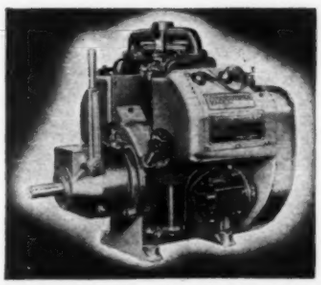
JOPLIN, MISSOURI, AIRPORT
Bids opened 11-12-41
U. S. Engineers, Tulsa, Oklahama

Items	Quantity	Unit	Low Bid Gray & Gravelle and Smith Bros. Okla. City, Okla.		2nd Low M. W. Watson Topeka, Kansas		Government Estimate	
1. Clearing	Sum	Job	.....	1,000	.....	1,000	.....	575
2. Excavation	347,000	Cu. Yd.	.25	86,750	.236	81,892	.179	62,113
3. Sodding and Seeding	870,700	Sq. Yd.	.025	21,770	.028	24,382	.009	7,837
4. Runway Base Course	162,200	Sq. Yd.	.72	116,784	.75	121,650	.644	104,456
5. Runway Tack Coat	28,385	Gallon	.10	2,838	.09	2,554	.119	3,377
6. Runway Surface Course	162,200	Sq.Yd.	.40	64,880	.45	72,990	.514	83,370
7. V.C. Skip Pipe, Drains, 12 inch Diameter	5,407	Lin. Ft.	2.50	13,517	2.90	15,680	2.10	11,354
8. Reinforced Concrete Pipe Drains, 12-inch Dia.	2,418	Lin. Ft.	2.00	4.836	1.50	3,627	2.19	5,295
9. Reinforced Concrete Pipe Drains, 18-inch Dia.	3,715	Lin. Ft.	3.00	11,145	2.10	7,801	3.64	13,522
10. Reinforced Concrete Pipe Drains, 24-inch Dia.	1,440	Lin. Ft.	4.00	5,760	3.00	4,320	4.76	6,854
11. Reinforced Concrete Pipe Drains, 36-inch Dia.	1,345	Lin. Ft.	7.00	9,415	6.00	8,070	8.00	10,760
12. Reinforced Concrete Pipe Drains, 48-inch Dia.	1,620	Lin. Ft.	10.00	16,200	10.00	16,200	11.22	18,176
13. Catch Basins, Type A	6	Each	300.00	1,800	260.00	1,560	366.00	2,196
14. Catch Basins, Type B	17	Each	225.00	3,825	110.00	1,870	246.45	4,189
15. Catch Basins, Type C	15	Each	75.00	1,125	45.00	675	91.40	1,371
16. Catch Basins, Type D	1	Each	.....	700	.....	470	.....	1,000
17. Headwalls	4	Each	50.00	200	30.00	120	42.00	168
18. Runway Markers	Sum	Job	.....	6,000	.....	5,700	.....	3,025
19. Corner Markers	Sum	Job	.....	1,500	.....	1,200	.....	1,130
20. Furnishing and Installing Auxiliary Platform Painting Beacon Tower	Sum	Job	.....	300	.....	1,200	.....	121
21. Electrical Work	Sum	Job	.....	40,000	.....	50,000	.....	28,730
22. Fencing	18,650	Lin. Ft.	.....	3,000	.26	4,849	.253	4,718
TOTAL				$413,346.00		$427,811.85		$374,643.23

OTHER BIDDERS

3. Concrete Mat'ls & Const. Co., Cedar Rapids, Iowa	$450,575.36
4. Hamilton Construction Co., Kansas City, Mo.	455,732.05
5. Chernus Construction Co., St. Louis, Mo.	470,951.49
6. Porter-DeWitt Construction Co., Wappapello, Mo.	487,805.60
7. Scherrer & Bennett Const. Co., Kansas City, Kans.	559,120.70
8. Samuel Kraus Co., St. Louis, Mo.	596,686.80
9. Missouri Petroleum Products Co., Clayton, Mo.	632,546.85
10. O'Dell & Riney Construction Co., Kirkwood, Mo.	649,671.25

Model VE-4
4 cycle 4 cylinder V-type, heavy-duty, air-cooled engine . . . delivers 22 hp. at 2600 R.P.M.



Draft Horses!

It figures out this way: 22 hp. packed into a 285-lb. heavy-duty engine, or 13 lbs. of compact engine weight for each husky horsepower. That's the sensational Wisconsin VE-4!

Harness this eager, dependable power to *your* kind of equipment and the kind of work you want it to do . . . the way it should be done. Detailed data on request. Write: Dept. H-12

MOST POWER PER POUND
HEAVY-DUTY AIR-COOLED ENGINES

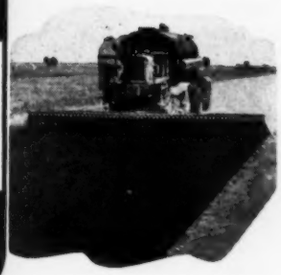
by WISCONSIN MOTOR CORPORATION
Milwaukee, Wisconsin, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

PLAY SAFE

PLACE ORDERS FOR SPRING DELIVERY

★ NOW ★



★ 1942 orders are already pouring in. Recognizing that the shortage of materials and skilled man-power is handicapping manufacturers, alert buyers of "Black Toppers," are getting in line this Fall to avoid delay next Spring.

While conditions are such that no guarantees can be made today regarding delivery, if you can estimate your requirements and place your orders *now*, we'll do everything in our power to make delivery early in 1942!

SEE YOUR DEALER or write us today for copy of "Foto-Facts" pictorial catalog. E. D. Etnyre & Co., Oregon, Illinois, U. S. A.

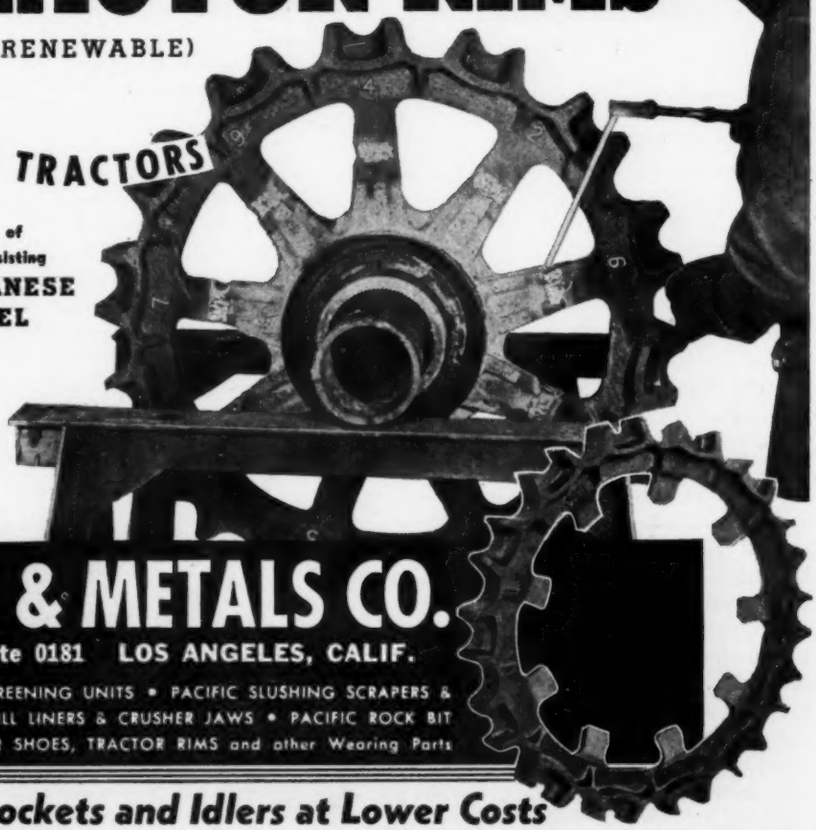
ETNYRE

BLACK TOPPER
BITUMINOUS DISTRIBUTORS

TRACTOR RIMS

(RENEWABLE)

made of wear-resisting **MANGANESE STEEL**



Substantial savings for busy tractor operators . . . Replace worn rims of sprockets and idlers with renewable Alloy-Manganese steel rims . . . They're abrasion-resistant, longer lasting and cost much less . . . Easily applied to old hubs . . . Welding instructions furnished.

Write for Bulletin No. 115

ALLOY STEEL & METALS CO.

1862 E. 55TH ST. LAfayette 0181 LOS ANGELES, CALIF.

Manufacturers of PACIFIC CRUSHING & SCREENING UNITS • PACIFIC SLUSHING SCRAPERS & SHEAVE BLOCKS • ALLOY-MANGANESE MILL LINERS & CRUSHER JAWS • PACIFIC ROCK BIT GRINDERS • HAND WINCHES • CRAWLER SHOES, TRACTOR RIMS and other Wearing Parts

ADDED LIFE for Sprockets and Idlers at Lower Costs

The price is in the City's trucks at the asphalt plant. The contract requires that the Midwest Paving Company be prepared to furnish hot sheet asphalt at any time during the day during the period of the contract. For this reason the price of $7.14 is considered exceptionally low. The City of Kansas City, Missouri, should consider itself fortunate to be able to buy on this basis at the above price.

R. B. Wills Dies.—Mr. R. B. Wills, Chief Engineer of the Kansas State Highway Department died in St. Luke's Hospital, Kansas City, Missouri, October 31, 1941. Mr. Wills was 45 years old. Last August he suffered a stroke and was taken to Mayo's at Rochester, Minnesota, where he underwent treatment. In the forepart of October he returned to Topeka, Kansas, where it was thought that he was improving, Just before his death he was taken ill and rushed to Kansas City where he died. Mr. Wills had been with the Kansas State Highway Department more than 20 years. He was assistant division engineer at Hutchinson, Kansas, from 1920 to 1929 and division engineer there from 1929 to 1933. He became assistant maintenance engineer at Topeka in 1933 and engineer of construction in 1934. He was manager of state highway planning from 1936 to 1937, engineer of design from 1937 to 1939, at which time he became chief engineer of the highway department. Mr. Wills was a member of the American Society of Civil Engineers and the Kansas Engineering Society. It it with considerable regret that we announce his death, as all of the contractors and engineers throughout this territory thought a great deal of him. His name will go down in history throughout this district as one of the finest men that the Highway in this section has ever had.

Survey Completed.—Mr. A. J. Kavenaugh, Secretary-Manager of the Oklahoma Good Roads Association, Cotton Exchange Building, Oklaloma City, Oklahoma, has just finished several surveys covering pavement including stabilized bases on several highway and airport jobs. Recently a prominent paving engineer made the statement that he considered these reports as good, if not better, than any he had ever seen. Mr. Kavenaugh is to be congratulated on the fine work he is doing. The Oklahoma Good Roads Association is an organization maintained for the betterment of roads throughout the State of Oklahoma.

New Equipment and Materials

LeTourneau Builds Scraper for Wheel Tractor

R. G. LeTourneau, Inc., announces the Model DLS Carryall Scraper, with a rated capacity of 8½ cubic yards struck and 11 heaped yards, for use with the new "Caterpillar" four-wheel tractor.

The Model DLS is very similar to the Model LS, which has proved successful with the Model C Tournapull. Chief changes are in the yoke for mounting on the pulling tractor and the position of the Power Control Unit. Cutting edge is 8 ft. 6 in. With

the apron cable dead ended on the apron, all hoist and unloading cables are now placed up and out of the dirt, eliminating abrasive cable wear.

The Model DLS is operated by cable from a standard LeTourneau Power Control Unit, specially adapted for use with the new "Caterpillar" wheel tractor.

New Pile Driver Attachment

A new rugged, yet light, lattice type pile driver attachment developed by the Buckeye Traction Ditcher Company, Findlay, Ohio, greatly increases the utility of their Clipper Crane.

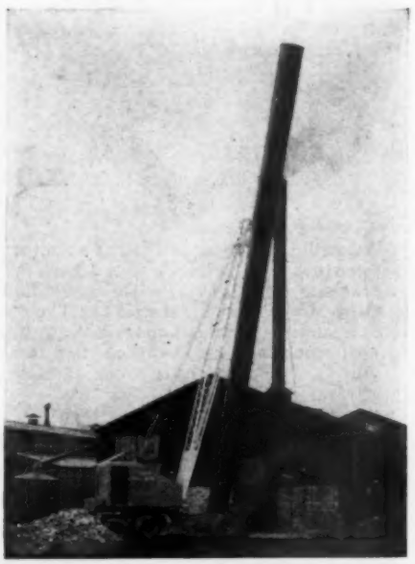
The leads of the unit are suspended from the boom point sheave shaft and are secured in such a way that they can be quickly unhooked. Leads or gibs are 30 ft. long and of heavy channel steel construction. The drop

hammer weighs 2,000 lbs., is quickly reeved and responds instantaneously to the vacuum power control by means of which it is operated. An impact resistant pile cap is designed to guide and protect wood piles being driven. Pilot and hammer are readily transported by truck.

Pile driver units are available with the Model 50, 5-ton; Model 60, 6½ ton or Model 70, 7 ton Clipper Cranes, any of which will readily hoist wood or steel piles into position for driving. All three models are quickly convertible to shovel or trench hoe or can be rapidly reeved for clamshell bucket or dragline operation. All operations in the working cycle of all attachments are by smooth, vacuum power control. Further information is available on request.

Model 205 WM Mobilcrane Is Announced

THE OSGOOD COMPANY of Marion, Ohio, in announcing the new Model 205WM MOBILCRANE, has taken another step towards completing their line of one-man, one-motor operated, pneumatic tired wheel mounted cranes. To date, The Osgood Company has placed on the market 15 and 20 ton MOBILCRANES. Now, they have available the model 205WM MOBILCRANE, which is of the 6 ton class.



The Model 205WM MOBILCRANE was developed to fulfill the need for a small, mobile unit, which would travel quickly from job to job, be easy to handle on the road and at

"SPRAY MASTER" PRESSURE DISTRIBUTOR

It's the most Modern Pressure Distributor made today. Exclusive Features give speed of operation and assure 100% Efficiency. Be sure your next Distributor is a "Spray Master."

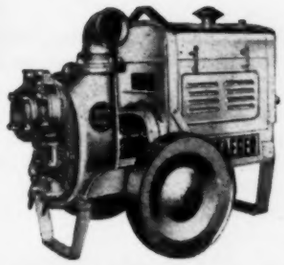
LB LITTLEFORD

LITTLEFORD BROS.
454 E. Pearl St., Cincinnati, O

3000 GALLON Bantam Pump

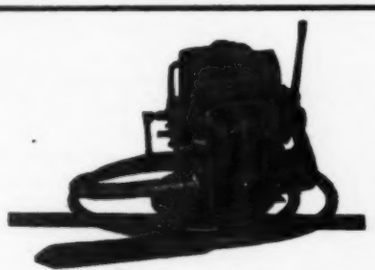
WEIGHS ONLY 52 LBS. COMPLETE WITH ENGINE

FASTEST PRIMING BIG CAPACITY LIGHT PUMP ON MARKET



JAEGER "SURE PRIME" PUMPS

Prime faster, pump full volume, pump more hours. 1½", 2", 3", 4", 6", 8", 10"; capacities to 240,000 G.P.H. Send for catalog. The Jaeger Machine Co., 223 Dublin Ave., Columbus, Ohio.



Concrete

VIBRATORS and GRINDERS

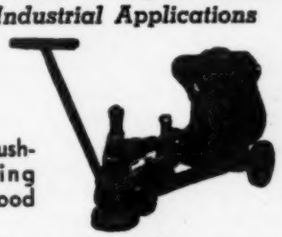
Write for Circular on types, sizes and Prices

ELKHART White Mfg. Co. INDIANA

"BERG" FLEXIBLE SHAFT EQUIPMENT

For Construction and Industrial Applications

Concrete Surfacers, Concrete Vibrators and Hi-Way Surfacers—for concrete construction.



Cleaning, grinding, wire brushing, sanding and polishing equipment—for use on wood and metal surfaces.

Available in electric motor and gasoline engine driven models.

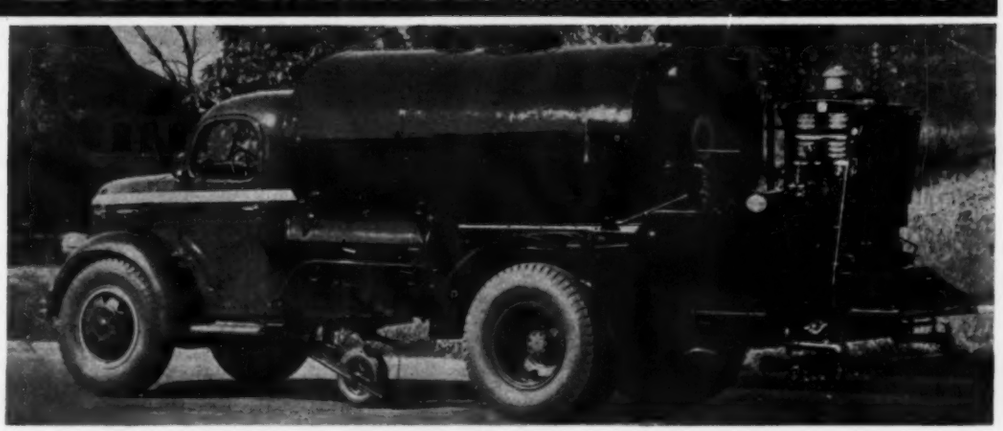
Write Department C

THE CONCRETE SURFACING MACHINERY CO.
CINCINNATI OHIO

South Bend BITUMINOUS MATERIAL DISTRIBUTOR

CONTINENTAL MOTORS — Powers a Fine Nation — AMERICA'S STANDARD

For complete information regarding the material distributor above shown, write direct to the Municipal Supply Company, South Bend, Ind.



POWERED BY Continental RED SEAL ENGINE

Dependable Red Seal Power is dependable *every hour* over a long period of useful life. That is why contract operators who must produce on schedule and who must produce economically, specify Continental Red Seal Engines.

Continental Motors Corporation
MUSKEGON, MICHIGAN

work, be operated by one man, and powered with but one motor. The Model 205WM has a wide range of speeds for traveling, has hydraulic steering, mechanical hydraulic brakes on rear wheels, and other features that lend to its mobility and usefulness as an excavator and material handler.

For information concerning the many other mechanical features of this machine write the manufacturer.

New Ozalid Model "B" Whiteprint Machine

Ozalid's new Model "B" Whiteprint machine, especially designed to meet industry's heaviest print making demands, is capable of producing finished whiteprints at speeds up to 20 per minute.

This newest Ozalid Whiteprint machine contains such features as synchronized printing and developing, permitting the use of continuous yardage as well as cut sheets . . . a temperature control for the printing cylinder so that the entire range of Ozalid sensitized materials can be printed with maximum results.

Other distinctive features claimed include front or rear delivery of prints . . . an adjustable burner shade to permit running prints of varying opacity without changing the printing speeds . . . an automatic air pickoff . . . and an effective blower hook-up.

The Model "B" combines printer and developer in one compact unit. It uses all of Ozalid's complete line of standard sensitized materials, transparent materials including foils, and specialties — paper coated on both sides, air mail weight paper, paper laminated on cloth and opaque cloth. It was placed on the market by Ozalid Products Division, General Aniline & Film Corporation, Johnson City, New York.

New Model MD6 Trackson Pipe-Layer

Trackson Company announces a new Model MD6 Pipe-Layer . . . a tractor side-crane that mounts on the new "Caterpillar" D6 model and takes full advantage of the increased power, ease of control and other improvements built into this latest "Caterpillar" Tractor.

The new MD6 Pipe-Layer has a lifting capacity ranging from 7300 lbs. at 12 ft. overhang, to 23,700 lbs. at 4 ft. overhang, and is one of a complete line of Trackson Pipe-Layers available with lifting capacities up to 67,000 lbs.

The newly announced Model MD6 Trackson Pipe-Layer is shown here. Bulletin 459, available from Trackson Company, Milwaukee, or from "Caterpillar" dealers, presents complete details.

Anchor Type Elastic Stop Nuts Now Available

Following the successful use of their anchor type nuts in aircraft construction, Elastic Stop Nut Corporation, 2332 Vauxhall Road, Union, New Jersey, now offers these nuts for blind-mounting applications on general industrial equipment.

Designed to provide vibration-proof fastenings for removable plates used to cover hand holes, access and inspection openings, and for other blind mount attachments, anchor nuts are permanently riveted to the inside of the structure. The bolts, which are inserted from the outside, pass first through the removable plate, thence through the structure into the stationary nuts.

These nuts are offered in a wide range of size, material, and thread system, every nut incorporating the basic Elastic Stop self-locking feature, a fiber locking collar which is an integral part of each nut.

A further explanation of the Elastic Stop self-locking principle, and a complete listing of the anchor nuts, are contained in a fully illustrated catalog which will be sent upon request to the manufacturer.

New Level Indicator for 55-Gallon Drums

A simple float indicator which shows the level of liquid in a drum has been placed on the market by U-C Indicator Sales, Milwaukee, Wis. The device consists of a cork float mounted on wire rods, the level of which is indicated on a gauge installed on the external fitting. This fitting takes the users faucet or spigot.

Ice Remover Products Improved

Tamco Ice Remover, manufactured by Tamms Silica Company, 228 N. La Salle Street, Chicago, Illinois, has now been made even more effective according to the manufacturer. It is stated that a new ingredient has been added that speeds the thawing process. Even at extreme sub-zero temperature, ice loosens from sidewalks, eave troughs, drains, etc., for instant, easy removal. Tamms Double Duty Ice Remover, has also been improved with the addition of a new faster acting abrasive that embeds itself in the ice more quickly—and prolongs its effectiveness. Any icy surface, regardless of low temperature becomes slip-proof the minute compound is sprinkled on. High winds will not blow it away. Neither product is injurious to concrete or lawns, and they do not leave white deposits when ice melts away.

WITH THE MANUFACTURERS

New Diamond Product

Diamond Iron Works, Inc., has announced it has taken over Porta Crane and that the line of portable hoists will be offered as Diamond Porta Cranes.

Open New Office

National Automotive Fibres, Inc., announce the establishment of a new sales office for their construction materials department at 101 Park Avenue, New York City.

Four Companies Join Asphalt Institute

Four asphalt producing companies were elected to membership in The Asphalt Institute at the recent Board of Directors' meeting held in San Francisco, it has been announced by Herbert Spencer, President of the Institute. The new members bring the total of companies constituting Asphalt Institute membership up to 29. Following is a list of the companies elected:

Home Oil and Refining Company, Great Falls, Montana.

Husky Refining Company, Cody, Wyoming.

Independent Refining Company, Billings, Montana.

Yale Oil Corporation, Billings, Montana.

The Asphalt Institute is a national association of asphalt producers, designed to develop the product and extend its uses through promotion, engineering activities and research. In the national emergency, it has also been geared to fullest cooperation in the construction of airfields, access roads and the strategic military net-work.

L. C. McAnly Appointed

L. C. McAnly has been appointed Works Manager of the Fruehauf Trailer Company, Detroit, according

to an announcement made by Harvey C. Fruehauf, President. McAnly has been in charge of manufacture for the Rockwood Manufacturing Company of Indianapolis, makers of power transmission equipment, for several years.

D. J. Shelton Now Heads The Marion Steam Shovel Company

At a meeting of the Board of Directors of The Marion Steam Shovel Company, Marion, Ohio, held in New York recently, D. J. Shelton, Vice-President of the company, was elected President and General Manager. The appointment was to succeed J. H. Watters, who has resigned to accept the Presidency of the Union Asbestos and Rubber Company of Chicago, Illinois. Mr. Watters will continue to serve as a member of the Board of Directors of The Marion Steam Shovel Company.

Alex Gibson, Treasurer of The Marion Steam Shovel Company was elected Vice-President of the company to fill the vacancy in that office created by the advancement of Mr. Shelton. Mr. Gibson will continue to serve the company as Treasurer.

Mr. Shelton is assuming his new duties immediately, taking over the management of a company for which he has worked for 32 years. Starting in as a shop maintenance man, he advanced steadily to Assistant Chief Engineer, a position he held for five years. He was then made Chief Engineer. He held this post for two years and was then advanced to Vice-President of the company. As Vice-President, Mr. Shelton was at first in charge of sales and engineering, a responsibility which was later extended to virtually every department of the company.

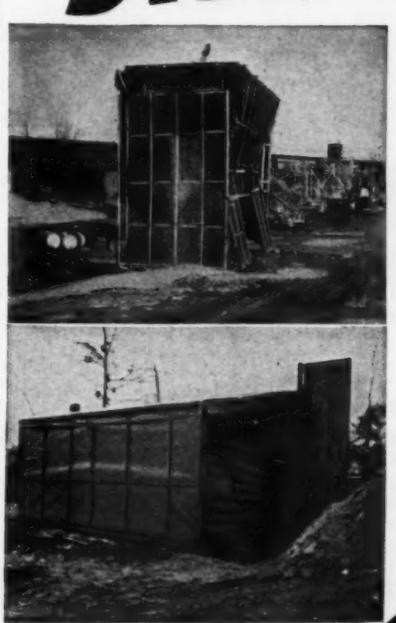
One of the first appointments to be made by Mr. Shelton upon taking over his new office was to place John P. Courtright in full charge of Marion's sales as Director of Sales. Mr. Courtright has been Sales Manager of the company since 1937.

New Advertising Manager Named by Chicago Pneumatic

Promotion of Joseph A. Sullivan, assistant publicity manager of Chicago Pneumatic Tool Co. to advertising manager has been announced by Leslie S. Gillette, sales development manager. Joining the Chicago Pneumatic organization in 1928, Mr. Sullivan served until 1932 as head of the direct-mail division of the company's publicity department. From 1932 until 1935, Mr. Sullivan was with Sweet's Catalog Service division of the F. W. Dodge Corporation as copy chief. In 1935, Mr. Sullivan rejoined Chicago Pneumatic as assistant publicity manager, responsible for the creation and production of all sales literature pertaining to the company's diversified line of products. Due to the greatly widened scope of its activities, Chicago Pneumatic's publicity department was recently reorganized as the sales promotion and advertising department under the direction of Mr. Gillette, to whom Mr. Sullivan will report. Previous to his association with Chicago Pneumatic and F. W. Dodge Corporation, Mr. Sullivan was assistant advertising manager of Columbia Phonograph Corporation and copywriter with the Biow Company, advertising agents.

SISALKRAFT

STOPS THEM ALL
Before They Stop You



Nothing else as practical and economical for covering up—closing in—keeping work going in spite of the weather. SISALKRAFT is the tough, waterproof, windproof, sisal-reenforced paper of endless uses. For example:

Temporary closures — steam-curing concrete — covering machinery and materials — covering aggregate to be heated by steam.

Available in rolls and blankets of almost any width. Inexpensive and durable. Have some on every job!

Write for Prices, Sizes and Samples.

THE SISALKRAFT CO.

Chicago . . . . . 205 W. Wacker Drive
New York . . . . . 101 Park Avenue
San Francisco . . 55 New Montgomery St.

New Trade Literature

Repairs and Replacements. — An interesting 4-page folder has been issued by R. G. Le Tourneau, Inc., Peoria, Ill., describing the manufacturers welding rod, wire rope, special steels, scraper blades, repair trucks and services. Copies are available on request.

Dust Control System.—The Kadco system of dust control is described in an unusual 6-page bulletin which gives complete details and specifications. Kadco Corporation, Long Island City, N. Y., is the manufacturer.

Safety Shoes.—Catalog No. 9 has recently been produced describing the line of rubber boots and shoes with steel safety toe manufactured by Lehigh Safety Shoe Co., Inc., Allentown, Pa. The possibility of the reduction of accident frequency and severity through the use of such safety items should be thoroughly investigated by the construction industry.

Parmanco
HORIZONTAL DRILLS

Stop . . . AND THINK!

Parmanco Drills have convinced owners of their true value—

In the Coal field, the Iron range, the Utility and the Contracting field.

We build a model for every need.
Parmanco Drills are now in their fourth year of successful operations.

WRITE US YOUR DRILLING PROBLEMS

PARIS MANUFACTURING CO., INC.
PARIS, ILLINOIS

Ice Control. — With the need for uninterrupted and safe winter traffic assuming even greater importance than ever this year, engineers and public officials will be interested in the latest manual on highway ice control issued by the Calcium Chloride Association. This new, fully illustrated bulletin, based on the practical experiences of nearly every ice-fighting state, covers all prases of ice control practice—from organization of the skidproofing program to actual use of methods, materials and equipment.

Copies of this 36-page handbook, in convenient pocket size, are available without charge by addressing the Calcium Chloride Association, 4145 Penobscot Bldg., Detroit, Mich., and asking for Bulletin No. 27.

Scraper.—One of the newest high speed earthmoving equipment on the market today is that combination outfit, the "Caterpillar" Diesel DW-10 Tractor and La Plant-Choate CW-10 "Carrimor" Scraper. A new booklet, completely illustrated, describes the scraper thoroughly and has just been released by La Plant-Choate Manufacturing Co., Inc., at Cedar Rapids, Iowa. The booklet is 16 pages in two colors and tells of the history and development of the scraper and describes the many design features, the bowl, hydraulic system, wheels and brakes. Included also is a section on the DW-10 "Carrimor" Scraper which is the same machine with front wheel assembly for use with track-type tractors.

Copies of the booklet may be obtained by writing the manufacturer or nearest dealer.

Friction Material. — A large illustrated brochure, recently issued, pictures numerous modern types of Gatke Friction Materials for all requirements of excavating, road building, and construction equipment, as well as trucks, rtactors, trailers, etc.

Included are Moulded Brake Blocks and Lining, Woven Brake Lining, Woven-Moulded Brake Lining in Sheets, Swinging Frictions in all shapes and sizes, Clutch Facings from 14 feet to 2 inches in diameter, Cone Type Clutch Facings, Gear Type Clutch Facings with integrally moulded teeth, and Moulded Clutch Block.

For a copy write to the Gatke Corporation, Chicago.

Screen Cloth.—A new 8-page bulletin describing their line of woven wire screen cloth has been issued by Robins Conveying Belt Company, Passaic, N. J. The metallurgy of wire is described and other valuable

information given such as the difference between "space" and "mesh," wire sizes, types of Robins screen cloth and its specifications. When writing ask for Bulletin No. 113 and mention this publication.

Construction Heaters.—Catalog 234 describing the Aeroil Burner Company line of kerosene burning heaters, torches and burners for winter use on construction jobs is now being distributed — copies are available at the main office in West New York, N. J., or at the various branch offices of the manufacturer.

Slusher Scrapers and Sheave Blocks.—Two bulletins have been received from Alloy Steel & Metals Co., 1862 E. 55th St., Los Angeles, Calif. Bulletin 95A describes the Pacific all-manganese steel scrapers for use with small portable slusher hoists. Bulletin 96A describes the manufacturer's line of sheave blocks and anchors. Copies are available on request.

Pavement Breaker.—A bulletin describing the recently announced small sized pavement breaking machine for both inside and outside work has been issued by the manufacturer, Rapid Pavement Breaker Corporation, 607 De Grau St., Brooklyn, N. Y. The two types of pneumatic junior machines are described.

Hydraulic Control.—Monarch Hy-Rocket hydraulic Power Control is described in a small folder recently has been issued by the manufacturer Monarch Road Machinery Company, Grand Rapids, Mich. The device described takes its power from the fan belt of the trucks or tractor and provides a means for the operation of snow plows, truck maintainers and similar equipment.

Heating Equipment.—A broadside has just been received from Littleford Bros., 457 E. Pearl St., Cincinnati, Ohio, describing that company's line of heating equipment for cold weather concrete construction. Included is a handy concrete temperature table in addition to a description of the Littleford line of heaters.

Bridge Railings.—A booklet discussing the design and construction of bridge railings has just been published by the American Institute of Steel Construction, 101 Park Ave., New York, N. Y. Sketches show typical details of various types of structural steel railings which have been designed in accordance with the requirements given in the booklet. In these requirements the Public Roads Administration concurs. Copies are free to interested persons.

Jaw Crushers.—A single sheet bulletin entitled "You Neew a Big Primary to Crush Big Rock" illustrates and describes the Cedarapids 25 x 40 Portable Jaw Crusher and Heavy Duty Steel Apron Rock Feeder. Two action pictures show this equipment in operation, one with an electric motor for power and the other powered by a diesel engine. Important features and complete specifications are given. This specification sheet may be obtained by writing direct to the Iowa Manufacturing Company or from any Cedarapids dealer.

Steel Forms. — A new catalog on steel forms for concrete pouring has been issued by the Blaw-Knox Company, Pittsburgh, Pa. The sixty-page booklet is profusely illustrated and there are construction photographs of many of the big-name concreting projects now under way, or just recently completed. Included in the descriptions are forms for circular, elliptical, horseshoe shaped and box shaped conduits, vehicular tunnels; walls, piers, dams, caissons, and bridge centering—and the new Blaw-Knox latch type hand handled forms are described and illustrated. Copies of the catalog (No. 1836) may be had by writing the Blaw-Knaw Division of Blaw-Knox Company.

Broom.—The Iowa Manufacturing Company of Cedar Rapids, Iowa, has just issued a new specification sheet illustrating their new Cedarapids

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BITUVIA ROAD TAR

Because of construction and maintenance economies and because of its traffic safety BITUVIA road tar construction offers distinct advantages to the contractor and to the public. Deep penetration holds the aggregate firmly for long service. BITUVIA is easily applied. It is highly resilent and skid-resistant. Made in seven types to meet any Federal, State, County or Municipal specifications.

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Operators and bosses all prefer Williams. Williams Welded Construction means longer wear . . . less breakage; faster work . . . more yardage! Williams buckets operate year in and year out with practically no cost for maintenance and repairs.

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THE WELLMAN ENGINEERING CO.
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WILLIAMS *Buckets* built by WELLMAN

"Traction Broom." This new bulletin shows three views of the equipment and describes its operation and special features. Ratios of travel and broom speed are given. The complete specifications are listed. Copies of this bulletin are available on request.

Jaw Crusher. — Bulletin No. A-4, just released by the Iowa Manufacturing Company of Cedar Rapids, Iowa, describes and illustrates exclusive features, construction details and design of Cedarapids Roller Bearing and Plain Bearing Jaw Crushers. Different jaw styles and types are shown and a chart is furnished for determining the average percentage expectancy. Specifications for the complete range of sizes from 9" x 12" to 25" x 40" are given. The bulletin has eight pages and is printed in two colors. Copies of the bulletin may be obtained by writing direct to the manufacturer or this magazine.

Calcium Chloride. — The Calcium Chloride Association announces the publication of a new bulletin, No. 26, titled, "Soil - Aggregate Stabilization and the Use of Calcium Chloride for Military Roads and Airport Runways." It is designed to cover the fundamental phases of dustlaying, surface consolidation and base stabilization. Construction details are given on projects at an Army airport and at a munitions plant. The use of calcium chloride in concrete work for military purposes is also discussed briefly. Free copies of Bulletin No. 26 may be secured by addressing the Calcium Chloride Association, 4145 Penobscot Bldg., Detroit, Mich.

Jaw Crushers. — The two sizes of Pacific jaw crushers (15 in. x 28 in. and 15 in. x 38 in. primary breakers) are fully described and illustrated in a new folder. Copies may be secured from the manufacturer, Alloys Steel & Metals Co., 1862 E. 55th St., Los Angeles, Calif.

Crusher.—The Iowa Manufacturing Company, of Cedar Rapids, Iowa, in their new bulletin K-2, describe and illustrate the Cedarapids "Kubit" Impact Breaker. The bulletin is eight pages and is printed in two colors. The product, the machine and tests of the product are thoroughly discussed. Construction features are well illustrated and operating advantages are carefully defined. Typical installations of the "Kubit" are shown. Dimensions and specifications of the four sizes of "Kubit" Breakers are included in the catalog. Copies of this bulletin may be secured by writing direct to the manufacturer or to this magazine.

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ELIMINATE WASTE

The Monotube Method provides cast-in-place concrete piles of the exact length to meet each job requirement. After driving the main lower tapered section, constant taper extensions are added to obtain the necessary total length. Installation is simple and speedy. Any number of extensions, which are available in 12", 14", 16" and 18" diameters, can be added in this manner. Extendable Monotubes up to 125 ft. in length have been installed successfully.

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Extendable Monotubes are light weight for easy handling, require no core or mandrel, can be driven with standard crane, leads and hammer, and lend themselves to thorough inspection after driving. Write today for complete information.

THE UNION METAL MANUFACTURING CO.
CANTON, OHIO

Belt Conveyors.—The booklet of 24 pages just issued by the Pioneer Engineering Works of Minneapolis, is a comprehensive illustrated statement of material conveyors made by this firm. There are many tables and full specifications, with drawings of the details of construction, and data on the capacity of various sizes of installation. Photographs show both portable units and permanent installations.

Welding for Hard Surfacing and Repairs.—"Amsco Welding Products" is the title of a 12-page booklet describing many modern uses of welding in the reclamation and repair of equipment and in hard surfacing. The text is systematically arranged and profusely illustrated. Write to American Manganese Steel Division of The American Brake Shoe and Foundry Co., Chicago Heights, Ill., for Bulletin No. 941W.

Diesel Power Units.—A new booklet has been published by Caterpillar Tractor Co., Peoria, Ill. Problems solved by application of Diesel power are discussed, and installations portrayed. The book deals with savings effected in a multiplicity of fields—irrigation, mining, cotton ginning, powering sawmills, milling flour, lighting construction jobs, drilling, feed milling, lumber finishing, poultry hatchery, construction equipment, ice and refrigeration, Marine Engine, heavy-duty hauling, sand, gravel and crushed rock, shovel, creamery, oil pumping, hammer mill, machine shop and locomotive. In requesting copies of this booklet ask for Form 6636.

Clam Shell Bucket.—A bulletin just published by The Hayward Company, 50 Church St., New York, N. Y., describes in detail the new Hayward Class K-6 digging type clam shell.

Tractor Shovel—The White Manufacturing Co., Elkhart, Ind., has issued a circular illustrating and describing the White loaders for wheeled tractors. Ask for Circular 36.

Bullgraders and Bulldozers.—A 24-page bulletin has been issued by the Bucyrus-Erie Co. on its new line of hydraulic bullgraders and bulldozers for International Tractors. Sixty photographs, plus drawings and diagrams "tell all" about construction details and design features. Actual field action shots tell the story of features turned into performance on the job. Complete specifications on bullgraders and bulldozers for International Trac-Tractors TD-6, TD-9, TD-14 and TD-18 are given in the bulletin, copies of which may be obtained by writing to Publicity Department, Bucyrus-Erie Co., South Milwaukee, Wis.

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Two-in-One Hammer Crusher

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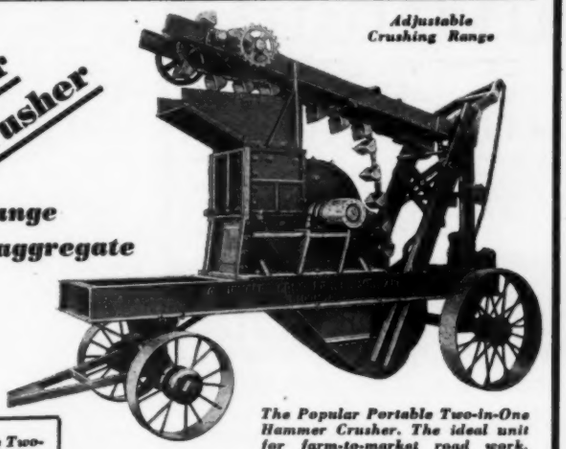
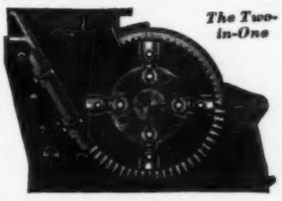


Adjustable Crushing Range

The Popular Portable Two-in-One Hammer Crusher. The ideal unit for farm-to-market road work.



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Cross Section View
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The above portable unit showing mounting on heavy steel trucks with folding bucket elevator, ready for traveling—the most durable design and very popular with contractors when operating from quarry to quarry.

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Shovel Dippers.—Bucyrus-Erie has published a vest-pocket sized booklet on dippers. Entitled "Shovel Output Begins with the Dipper," the little booklet tells about the importance of dippers to shovel output and delivers all the facts about Bucyrus-Erie dippers. Copies may be obtained by writing to Publicity Department, Bucyrus-Erie Company, South Milwaukee, Wis.

Dippers and Parts.—Two new bulletins of unusual interest have recently been issued by the American Manganese Steel Division of The American Brake Shoe & Foundry Company.

Described and illustrated in a 24-page bulletin, No. 641-D, are design changes of the Amsco Renewable Lip Dipper, standard present day models and some special types of dippers; as well as dipper teeth, lips, fronts, backs, doors and other parts designed to meet specific digging conditions.

A separate 8-page bulletin, No. 641-S, gives complete details on power shovel and dragline parts of genuine 13% manganese steel. Parts such as dipper stick racks and pinions, boom sheaves, crawler idlers, rollers, tumblers, and treads for power shovels are shown, as well as other parts that are subjected to abrasive wear or impact in heavy duty service.

Copies of these bulletins are available on request.

Pipe Culvert.—A pocket size catalog of 24 pages describes the metal arch culvert and standard full circle culverts manufactured by The Firman L. Carswell Mfg. Co. In addition to a description of the mechanical features of the product the book contains valuable tables on comparative areas, drainage and excavation.

Portable Roller. — A folder illustrating the use of their roller for patch work has been released by Littleford Bros., Cincinnati, Ohio.

General Catalog. — A new catalog has been issued by White Manufacturing Company, Elkhart, Indiana, which covers the manufacturer's entire line of machinery for the construction and maintenance of roads and streets. Copies may be obtained from the manufacturer by asking for Catalog 32-A and mentioning this magazine.

Scrapers.—A new catalog printed in four colors containing 12 pages of information, facts and illustrations on the Tournapull, Models C and Super C, has been released by R. G. LeTourneau, Inc., Peoria, Ill. This new booklet gives condensed specifications of both Tournapulls, Model C and Super C. When writing ask for Form TP-104.

All-Wheel-Drive Catalog. — Marmon-Herrington, Indianapolis, Indiana, has for distribution their new, two colored, catalog of All-Wheel-Drive equipment for trucks, commercial cars, and passenger cars. Besides furnishing engineering features and specifications, many pictures are included to show the various types of vehicles that have All-Wheel-Drive installations. The equipment which gives *"live power"* to all wheels is clearly illustrated in a phantom view of a chassis installation. Your copy will be mailed to you upon request.

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CONCRETE PAVERS
Single drum 27-E and 34-E models. Also tower and inclined boom pavers. *Catalogs on request.*
ADNUN
BLACK TOP PAVERS
For Black Top paving and rock spreading. Only machine with continuous course correction.
Ask for Catalog.
THE FOOTE COMPANY, INC.
Nunda • New York

Stemming.—A new stemming material which is claimed to increase blasting efficiency is described in a new folder issued by the manufacturer, National Automotive Fibres, Inc. Copies of this bulletin and free samples of the product are available.

Tamping Roller.—A 4-page folder, explaining the exclusive features of their power driven tamping roller is being distributed by Contractors Machinery Corp. and Trojan Sales Co.

Patrol Grader. — Contractors Machinery Co., Inc., has released a bulletin giving a complete description of their utility patrol grader together with specifications. Write to this magazine for copies of this bulletin.

Cleaning Manual.—An interesting, illustrated, 12-page booklet prepared primarily for maintenance superintendents and foremen and packed with the latest, up-to-the-minute "how to do it" information on cleaning a wide range of road building and construction equipment before repair and repainting or for regular maintenance, has just been issued by Oakite Products, Inc., manufacturers of specialized industrial cleaning materials.

Copies of this booklet, Form No. 4253R, are available upon request.

Concrete Highways and Public Improvements, a publication by the Portland Cement Association, contains several articles on improvements and modernization with concrete in their November-December issue. One of the most interesting explains the application of movable divisional fins on the Chicago Express Drive in solving bottle neck traffic problems. Complete picture illustrations are given to show how the widths of traffic lanes are adjusted with the movable fins to ease the heavy flow of traffic. Close up views show the details of the equipment. Copies are available upon request to the Association at its offices, 33 West Grand Ave., Chicago, Ill.

Bituminous Mixer. — A bulletin illustrating and describing a new and larger size bituminous mixer in the Kwik-Mix line has been released. The mixer is designed for service in maintenance departments of states, counties and municipalities, as well as for contractors who pave driveways, parking lots, tennis courts and filling station approaches. Copies may be secured by writing Kwik-Mix Concrete Mixer Co., Port Washington, Wis., and asking for bulletin KM173.

Paver. — The MultiFoote Single Drum 34E Paver is described in a new catalog just issued by the manufacturer, Foote Co., Nunda, New York. The book is characterized by clear cut illustrations of the mechanical features of the machine. Copies may be secured from the manufacturer.

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TRACTORS

Cletrac "DDH" Hillside Model Tractor No. 1-L-2982 with Hercules Diesel 61 H.P. motor, 18" tracks, overhauled and in very good condition.
Cat. "60" Tractor in operating condition.

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Austin-Western 5 yard cable scraper, good condition.
Austin-Western winch for above scraper, to fit any standard crawler tractor.
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Ball Wagon, 3 yard, working condition.
Page ¾ yard dragline bucket complete, reconditioned and in excellent condition. Painted red.
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Ryan 12 Ft. Grader, power controlled, leaning frame, steel tired roller bearing wheels, in operating condition.
Adams 8 ft. Grader with good solid rubber tires, roller bearing wheels, painted yellow. Good condition.

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Simplicity 3 deck screen, 3' x 6' without screen cloth, painted gray, excellent condition.
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Waukesha 4 cyl. 40 H. P. Power unit complete with clutch, 16" pulley with Gates No. 210-C "V" belts. Painted yellow, very good condition.
LeRoi 4 cyl. Power unit on skids, Motor No. 80095, with 2 to 1 reduction gear and clutch, hood sides. No pulley. Painted yellow. In new condition.
No. 165 Austin Gyratory Crusher with back gear on steel tired trucks. Excellent condition.

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Unrestricted Parking to 3 a.m.

Dependable Used Equipment

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1—Ingersoll-Rand Compressor, mounted on 4 pneumatic tired wheels, latest air flow model—only 6 weeks old..... 1775.00
1—Sullivan Compressor Model WJ3—Angle Compound—belt type—2 stage—468 CFM Displacement 1350.00
1—⅝ yard Northwest Crane No. 3 Crawler Type—Powered by gasoline engine—40' Lattice Type Boom—with ⅝ yard Williams Clam Bucket..... 4500.00
Shovel front available at extra cost.
1—Traylor Reduction Crusher, Model TY, Size 1' x 8"—A-1 condition—ready to operate 1800.00
1—24x16 New Holland Roll Crusher. Like new 875.00
1—10x30 Wheeling Crusher, roller bearing jaw type. First-class condition..... 1675.00
1—10x40 Good Roads Crusher—Jaw Type—overhead eccentric—Completely rebuilt. 2850.00
1—"Caterpillar" Diesel D8800 Power Unit, 4 cylinder, 80 HP, extended shaft and outboard bearing 1875.00
1—"Caterpillar" D17000 Diesel 8 cylinder Power Unit—160 HP at 850 RPM..... 4500.00
1—Fairbanks-Morse Diesel Engine, 560 HP at 257 RPM—16" bore 20" stroke— 4 cylinder with magnetic clutch and compressor for starting.....Price on application
1—Koehler Gas-Electric Generator Set 5KVA 120-240 volts single phase, powered by 4-cylinder gasoline engine complete with 32V starting arrangement.. 500.00
1—"Caterpillar" No. 10 Motor Grader—gasoline—equipped with leaning front wheels, 10' blade, tandem drive with scarifier 2450.00
Extra for scarifier..... 150.00
2—"Caterpillar" Motor Graders—Model 212 Tandem Drive leaning front wheels, 10' blade—latest models—3 months old—like new .....Each 3375.00
1—Clyde double drum heavy duty hoist, powered by Waukesha 20 HP gasoline engine, 3400 lb. line pull at 138 FPM 595.00
1—Huber 10-Ton, 3-wheel Roller, powered by 4 cylinder gasoline engine—A-1 condition 2350.00
1—10-ton Buffalo-Springfield 3-wheel Roller, latest type, powered by 6 cylinder engine—Almost like new only slightly used 3750.00
1—5-ton Gallon, 3-wheel Roller, powered by McCormick-Deering gasoline engine 1250.00
1—LeTourneau Model U-9 Scraper in A-1 condition—7.7 struck capacity; 10 yd. heaped capacity 2975.00
1—LeTourneau Model G⁴ Scraper—Struck Capacity 6.1—Heaped Capacity 6.5—PCU not included..... 1735.00
1—LeTourneau Model LS Scraper—8.2 yd. Struck Capacity—11 yd. Heaped Capacity—PCU not included..... 3600.00
1—New Holland Vibrating Screen—Size 3' x 8—2 deck—used only 30 days..... 800.00
1—Bucyrus-Erie Model 10-B Shovel—Crawler Type—Combination Shovel & Crane Booms—Good condition..... 3750.00
1—Hanson ⅝ yd. Model 30 Combination Shovel and Crane—30' Crane Boom and Tagline—Factory rebuilt in 1941..... 4000.00
1—"Caterpillar RD8 Tractor—completely rebuilt — equipped with LeTourneau double drum power control unit and LeTourneau Model JR12 Scraper..... 10,000.00
1—"Caterpillar" D6 45 HP Tractor—equipped with DD PCU and LeTourneau G6 Scraper—Only used 500 hours..... 5750.00
2—Vulcan No. 1 Steam Pile Hammers—A-1 condition.....Price on application
1—Link Belt Model K55 Crane—Powered by Climax 6 cylinder gasoline engine—75' boom in 30'—25' and 2—10' sections 9000.00
1—Austin-Western Vibrating Screen — 2 deck—3' x 8'—A-1 condition..... 600.00

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800 West Main Street
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by

Manufacturer of Snow Plow Warning Light. Those contacting State, County, and Township Officials and handling noncompeting lines desired. Product is well established and well received.

Address Box 443, Roads and Streets, 330 S. Wells Street, Chicago, Ill.

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NEW AND USED EQUIPMENT FOR IMMEDIATE SHIPMENT

Subject to Prior Sale

NEW —32" Cage Mill, 3 to 4" feed, rock or gravel, good for maximum 50% crushing. 40 to 60 tons per hour.

NEW —Steel Truck and Wheels, equipped with new pneumatic tires, tongue for tractor hitch, 10-ton capacity, for mounting 40 x 20" rolls or 15" x 36" Crusher.

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USED—Model 101 Type K DAY Limestone Pulverizer, 2 to 3 tons capacity.

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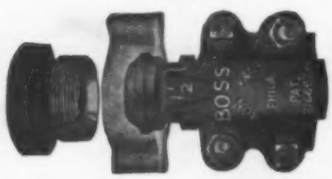

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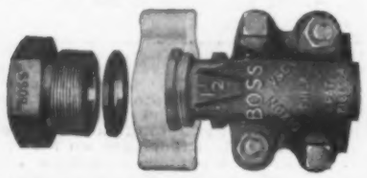

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